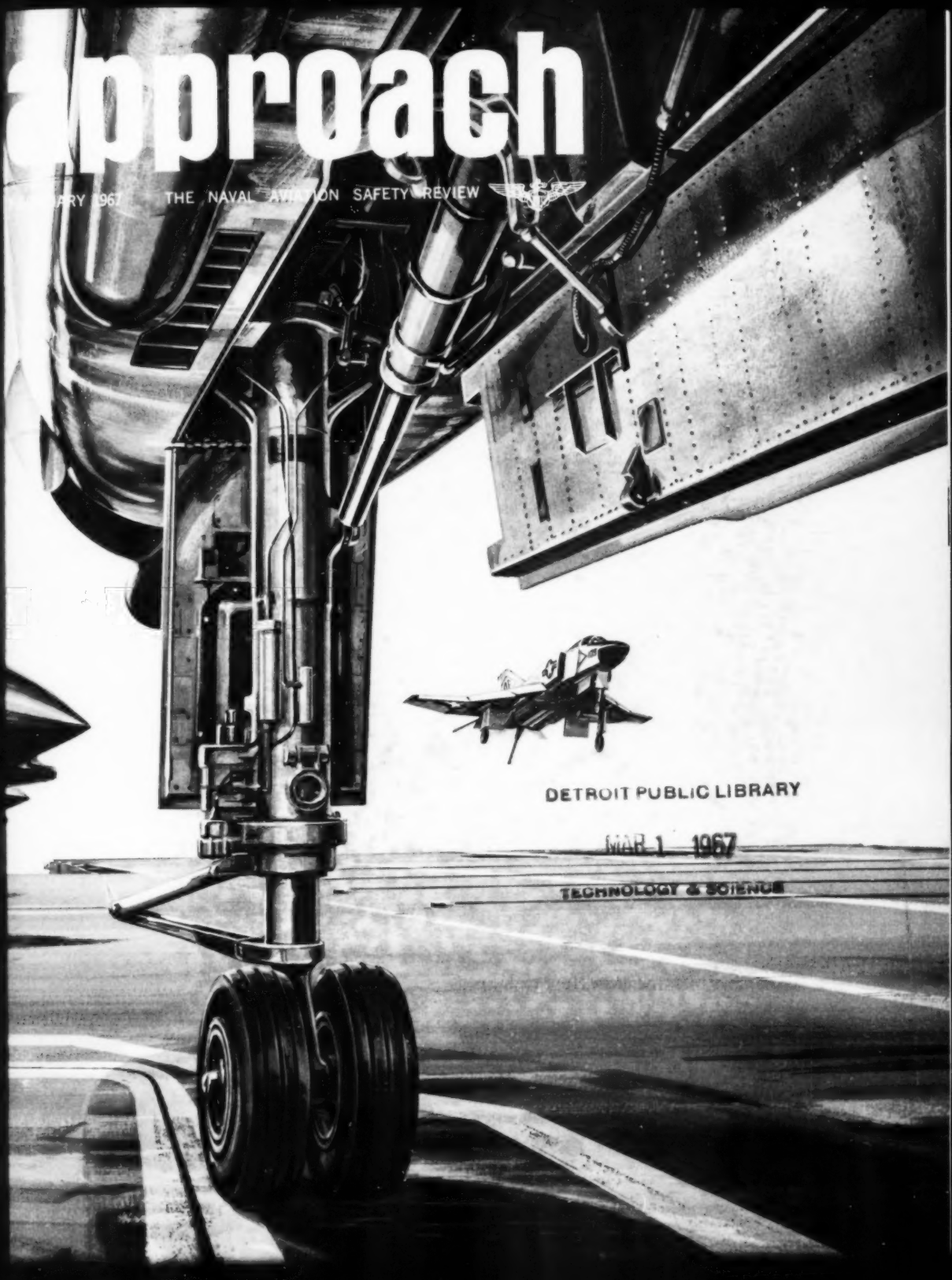
Approach

ARY 1967 THE NAVAL AVIATION SAFETY REVIEW



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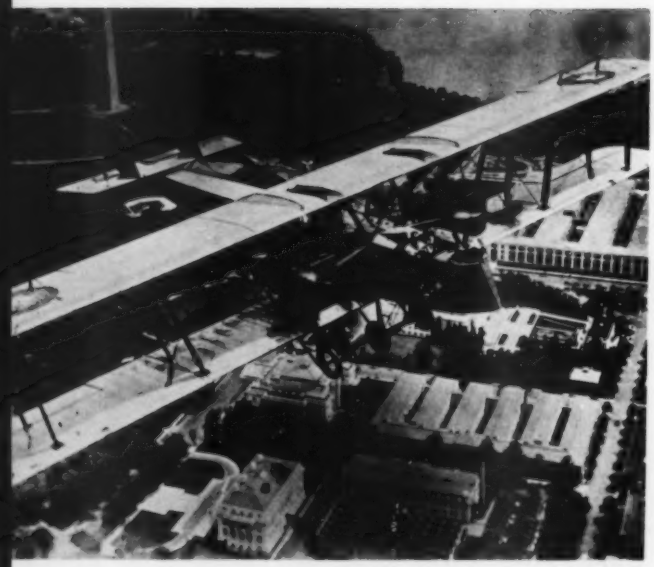
TECHNOLOGY & SCIENCE

LIVING WITH FOLDING WINGS

By COL J. H. Reinburg USMCR



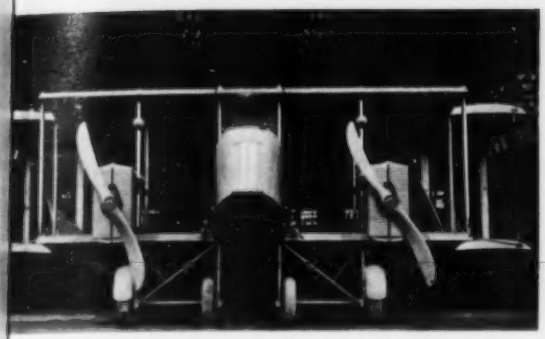
The Air Corps MB-2 Bomber of 1920. The Navy ordered a few of these with folding wings.

Through the years, many a Naval Aviator has griped about folding wings on his aircraft. Some have had personal scares concerning an inadvertent wing-folding incident and a few have seen a real accident.

All experienced aviators know every moving part on an airplane is a potential source of trouble. With this view in mind, the flyers would prefer to see folding wings eliminated. Moreover, they see the obvious weight penalty to carry the mechanisms. The individual pilot, looking only at the small picture, sees folding wings as just one more obstacle to make flying less enjoyable and precarious.

To fully understand the folding wing big picture, a short bit of history might help.

Folding wing airplanes became common in the U.S. Navy in the 1930's after an initial start in 1920. Due to limited deck space on aircraft carriers, the gain was obvious, more planes per carrier. The penalties were also evident: reduced performance and extra human error problems. Through World War II and subsequently, folding wing aircraft have earned their keep for carrier operations. Con-



And this was the result, any volunteers?

This folding wing SOC was in operational use from USN large warships in the 1930s.

sequently, designing reliable folding wing mechanisms has become an art unto itself. Today, the weight penalty (and attendant performance degradation) has been minimized in high powered supersonic jets.

The first real test of the value of our folding wing aircraft presented itself in World War II. The Japanese went a different route. They eliminated all possible weight to gain aircraft performance, hence none of their carrier aircraft had folding wings. The end result was that they carried fewer aircraft than our carriers of equivalent size. In the Battle of the Coral Sea, two of our carriers opposed three of theirs. Each of us lost one carrier and history records the battle essentially as a draw. In the Battle of Midway, the Japanese had four carriers against three

First Navy folding wing monoplane was the TBD. It used the same overhead principle as the A-1.

Note the USS ESSEX in World War II. The parked planes vividly display the deck space gains with folded wings.

he F4F-4 was the Navy's first folding wing fighter. It did oble service at Midway and has been called the savior of uadalcanal. This wing fold design, although complicated, lters pilot error more than the simpler overhead fold type. Nevertheless, a number of pilots have tried to takeoff with this

2

of ours. We won that battle, decisively, because they lost all four carriers to one of ours.

Out of this analogy, it is rash to say we did not lose because of the folding wing aircraft differential, but it is food for thought.

In the early months of World War II, many of our Navy and Marine pilots felt that folding wings put them at a severe disadvantage against the enemy. The mere mention of the name of the standard Japanese fighter "*Zero*" struck fear in the hearts of many Americans, especially combat aviators, because it was known to be a superb dog fighter with little unnecessary weight. It was soon discovered, happily, that the performance penalty was more than offset by our more ruggedly built aircraft with armor protection and better firepower. We could survive many hits while the Japanese planes could not.

Records show that since 1 July 1957 there have been 237 wing-fold accidents and incidents attributed to USN and USMC aircraft. Few of these, fortunately, have resulted in personnel injury. Without folding wings our carrier aircraft complement would be reduced by about one-third, and the handling accident rate would increase because spread wing aircraft are much more difficult to manipulate.

History has been the vindicator of the folding wing decision so we must work to eliminate the accidents attributed to these space saving designs, and quit griping about their presence. These accidents have

Size and limited carrier space dictates many folds.

many causes but the most costly one is pilot error. Almost all of the losses are caused by haste and/or failure to adhere religiously to the check-off list. Of the remaining wing-fold accidents, almost all of them are maintenance errors, usually occurring after a wing change or locking mechanism repair.

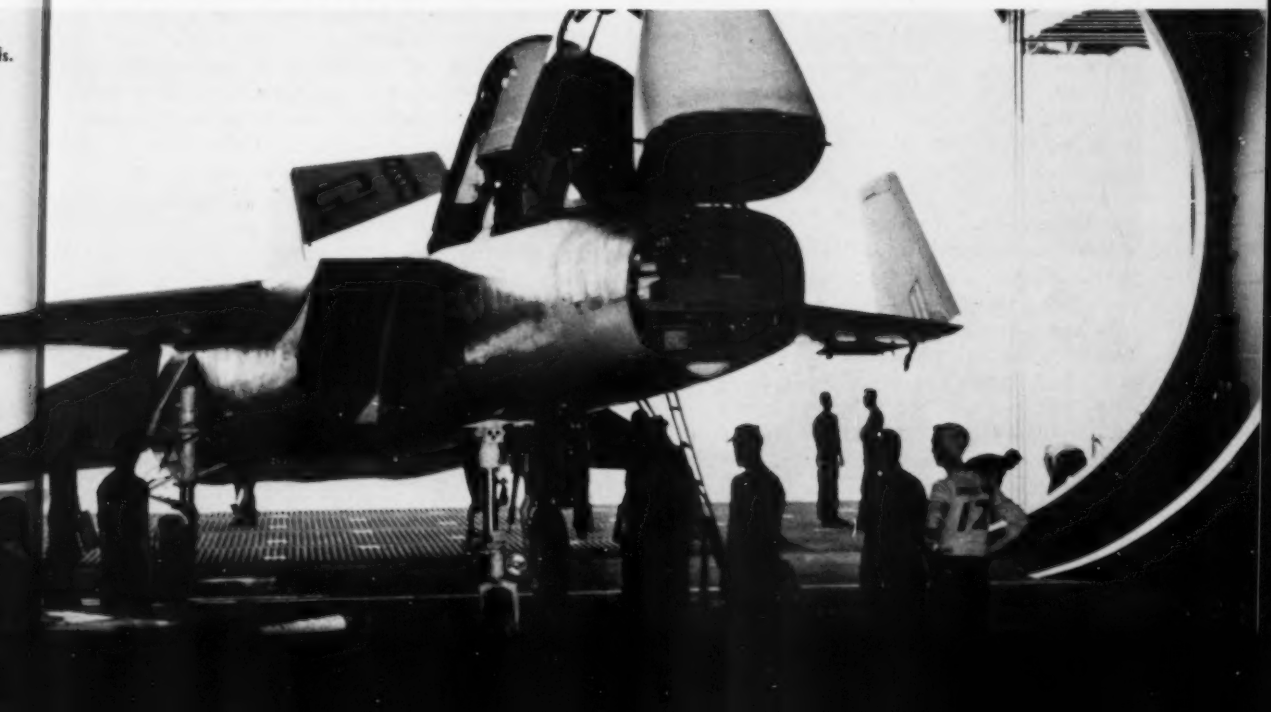
Aircraft designers have made real progress in making wing-fold mechanisms as reliable and foolproof as possible. Unfortunately, it is impossible to improve the basic design of the human body flying the aircraft.

Here are F-8s demonstrating all of their wing variations.

In naval aviation (as in other air forces) there must be a constantly flowing pipe line of new pilots, crewmen and maintenance personnel. This is the same model of human since time immemorial so that, unlike new airplanes, we always start from scratch with human Mk-1 (the flesh and blood model made with unskilled labor). The only starting gain we can look forward to is improved teaching methods.

The most recent folding wing accident is probably the most unique. An F-8 pilot followed NATOPS to the letter. Upon taxiing away from the line, his wings were down, locked and properly checked by the ground crew. While moving to the takeoff position, he chanced to meet a large transport plane who wished to share the same pavement with him. Being a gentleman, our pilot, no doubt, thought all chances of a ground collision would surely be avoided if he made himself (the airplane) as small as possible. Obligingly, he flipped the lever and folded his wings. Instantly, upon passing the big ship, the pilot became engrossed in finding his way in the dark and never gave another thought to those little ole' wing tips—way back beyond one's normal peripheral vision. Moreover, a hard turn of the head would reveal little in the darkness, and equipment (oxygen, radio lines, shoulder straps, etc.) was added swivel impediment.

At the head of the runway, the pilot was quickly ready for takeoff after a few more required checklist items. Wings were not one of them because they were on the list to be followed back at the line. Perhaps the pilot could almost go through the check lists by heart—which means by habit—and he was not



Looking at the A-1 on the left, one may find it hard to believe but several pilots have gotten them airborne with wings folded. The A-3 on the right, has a folding vertical stabilizer to clear hangar ceilings.

in the habit of folding wings en route to or at the takeoff position. So, there was no precedent for intermediate wing spreading and precious fuel was being wasted while sitting on the end of the runway.

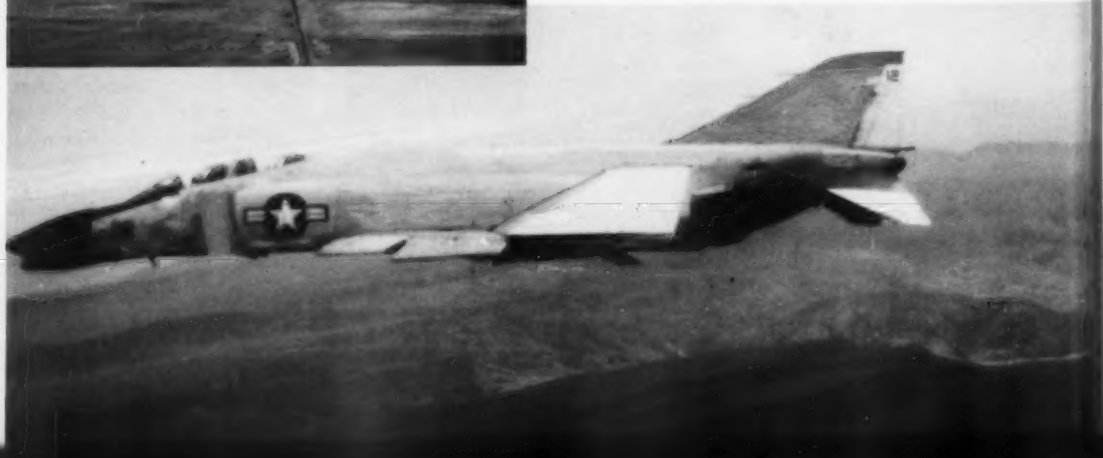
Blast off was normal and the slightly longer run to get airborne might have been attributed to night illusions, as the pilot did give it only a bare moment's thought. After liftoff and wheel retraction, the pilot did feel that yaw and pitch were abnormally sensitive.

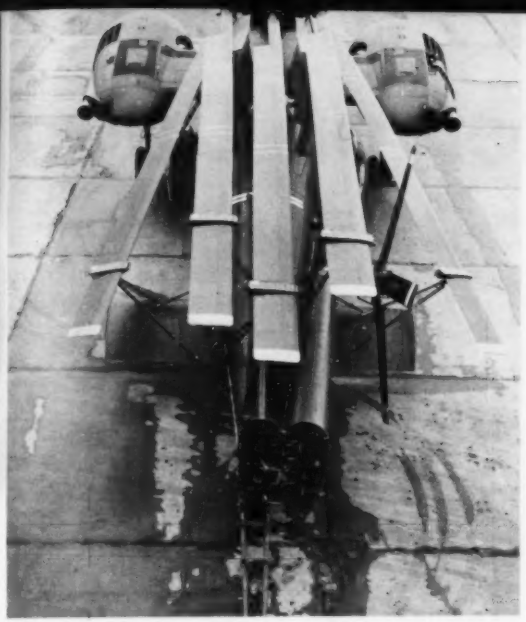
After lowering the wing (the F-8 changes angle of attack for takeoff and landings) and continuing the climb accelerating past 200 kts, the pilot finally became alarmed because of definite and obvious oversize pitch and yaw gyrations. Other than fluctuating hydraulic pressures, no other systems malfunctions could be found.

When the wing would not lock down, the pilot ceased climbing at about 5000 ft and planned to abort the mission. No doubt, enough malfunctions had now become unsolvable so as to make a return to earth attractive. In fact, it seems evident that the pilot was sufficiently alarmed (perhaps something in the back of his mind told him that he had excessive vertical stabilizer assistance robbed from horizontal lift) so as to throw landing check lists to the wind in haste to return to base.

Maybe you will not believe it, but the pilot succeeded in getting back on the runway, wheels-up unfortunately. Or, perhaps it was fortunate, because the

Sorry 'bout that!





As shown in this H-37 picture, helicopters also must conform to space saving folds.

reduced wing area obviously required abnormally high approach speeds to safely fly back to the strip and stopping on the runway would have been difficult to say the least. Just before touchdown, the pilot said he thought about the wheels and flipped their handle down—too late. However, no fire occurred and the pilot got out, unaided, from the well bent bird.

Another wing-folding incident recently occurred to an F-4 upon being launched from a carrier. Just before takeoff, confusion reigned over a downed aircraft on the catapult. Consequently, in the haste to get the launchings back on schedule, the plane was fired off with the wings spread but unlocked. Upon becoming airborne, the wings began to fold. Only the high power of the F-4's afterburners kept this plane in the air. A successful and unharmed landing, with the wing tips still vertical, was accomplished at a shore station. Readers should be relieved to know that the F-4 can survive as a stubby-wing fighter and further experimentation is not necessary.

The third recent wing-folding occurrence has no humor as did the first two mentioned because the pilot was badly hurt, although he did miraculously survive. Following a navigation/bombing hop, the pilot was to return to his home base and have the wing racks cleared before turning the A-6 over to O&R at a nearby base. It was not necessary to refuel the plane so the pilot kept the engines running while underwing paraphernalia was removed, and the bombadier/navigator departed. Unfortunately, upon landing from the operational flight, nose wheel steering difficulties were experienced thereby necessitating excessive differential braking. The heat generated by the brake beating led to a wheel change so the engines were secured and the pilot retired for lunch while the work was in progress.

Two hours later, the A-6 was ready for the short delivery flight. The pilot performed a hasty preflight, start and taxied away from the line. En route to the end of the runway, the pilot (alone in the two seater) waved the plane captain and taxi signalman out of his way and proceeded to spread his wings shunning their assistance. Intermingled with wing spreading, flap and slat lowering, the pilot hastily requested tower takeoff clearance, which was summarily granted. No time was wasted in taking off upon reaching the end of the runway. The board concluded that this break in habit pattern and the anxiety to get on with the ferry flight caused the pilot to neglect locking the wings.

The A-6 got airborne in a normal fashion but upon climbing through about 75 ft of altitude, the left wing began folding. Following this, the plane slowly rolled to the left and the nose began dropping from a rather steep climbing attitude. Upon completing the left slow roll, the right wing began to fold as the plane continued rolling left. At this time, the pilot ejected at an estimated altitude of 50 ft. Only the drogue chute deployed as the pilot hit the sandy soil off of the runway barely separating from his seat. The plane burst into flames upon impact some 50 ft beyond the pilot.

The board assigned 100 percent pilot error to this costly accident.

Through the years, almost every operational airplane and helicopter with folding wings, rotor blades, vertical stabilizers, variable wing incidence mechanisms (F-8), etc., have had their incidents and/or accidents. The only sure cure is to keep 'em in the hangar. However, this defeats the operational mission. So we must learn to live (make them work safely and stay alive) with these folding gadgets.

Very much like most wheels-up accidents, folding wing mishaps follow a pattern; a warning signal. Something has occurred to alter the normal check-off list habits, procedures, etc. In the three cases mentioned, two were in haste to get back on schedule thereby cutting short established safety checks. The other was wing folding to allow a big airplane to pass—an abnormal situation. The moral of this story is that any time events cause a change or alteration to check-off list routines, be forewarned that a possible accident is looking for a place to happen.

Just a Matter of Days

One CO reveals how one-day safety meetings battled complacency in his squadron.

Editor's Comment—Traditionally there have been more aircraft accidents during the months of July, August and September than any other time of the year. However, no single cause-factor accounts for this particular phenomenon.

In an effort to erase this tradition, ComNavAirLant in July 1966 directed all of NavAirLant to devote one-half day toward reviewing operating procedures, with respect to safety. The primary purpose of this safety review was to attempt to achieve another substantial reduction in aircraft accidents by stimulating a renewed and increased safety awareness on the part of every man. In spite of a splendid aviation safety record in VC-3 (more than 19,000 accident-free hours in 25 calendar months), the commanding officer became concerned over a growing attitude of complacency by all hands. Recognizing the symptoms, he cast about for a method of achieving 100 percent interest in aviation safety by the officers and supervisors of the squadron.

It was decided to try a one-day aviation safety seminar at the squadron level. No criteria or precedent existed for holding this type of event so Yankee ingenuity came into play.

The results were most impressive. Problem areas were uncovered and treated which no one in the upper level of the squadron were aware existed. But the most important and beneficial aspect of the seminar was the new all hands awareness of the problems and a willingness to do something about them. The success of this first safety seminar guarantees that it will become a semi-annual event in VC-3.

A similar method for solving and assisting the overall squadron safety program was utilized by VS-34. See the July 1966 issue of APPROACH *for additional treatment of the subject.*

"It's just a matter of days until this squadron suffers a serious accident" began the Commanding Officer. "It has been proven on an actuarial basis that an accident will occur with a given frequency under all normal operating conditions in each squadron of the Navy.

"It is our task here this morning to change the 'normal' operating conditions which prevail in the hope that it will change the 'normal actuarial' basis on which the probabilities of an accident are computed."

By CDR Thomas A. Loomis,

Commanding Officer, VC-3

These were the startling words with which the squadron commanding officer led off a squadron aviation safety seminar with all officers and first line supervisors participating.

The commanding officer was certainly a conscientious gent when it came to aviation safety. He believed in the NATOPS/Standardization program and had taken positive steps to insure its complete adequacy; he knew that the squadron had an effective maintenance department as attended by a vital quality control program and their use of all the modern 3M management methods and trend analysis tools. A continuous program of safety education and pilot indoctrination was evident in the squadron under the guidance of a stout hearted, effective safety officer. But in spite of the existence of these essential components of a vital safety program combined with vigorous command attention in all areas of aviation safety, a serious deficiency still existed.

The commanding officer was aware that safety consciousness seemed to be concentrated at the top level of the squadron. It almost seemed as though only a few of the 65 officers assigned spoke and taught aviation safety. Everyone else sat back in the All Officers Meeting and listened to the Commanding Officer. Executive Officer, Safety Officer or an occasional Department Head give a little pitch on safety. The average pilot was always receiving and never giving—he never had the chance to demonstrate to his leader, to his subordinates or to his associates that he too had a lot of creator-endowed smarts on this subject. But no one ever gave the junior pilot a real chance to sound off with his observations and ideas. After all, who can successfully compete with the 'old man' or the XO and their thousands of hours in the weekly meeting?

Complacency had indeed taken place in our squadron after 19,000 hours of accident-free flying.

Recognizing this complacency the CO wanted to know, "How can I reverse this trend? How can I get all hands to think and speak and act safety as well as listen safety and how can I do this now? Today."

Taking a page from his experience as a flight instructor in the Advanced Flight Training Command, he recalled the "Back in the Saddle" programs which were proven to be so effective in reducing aviation accidents following the holiday leave periods. He

C103-PI-665
Contributed by VA-106, FPO New York, N.Y.
Same old thing, we can hack it. Piece of cake.
O.K. Wingman, The weather is poor, but we have been here many times. I know the target cold!
crash!
Brief?? But sir, it was the same old hop, you know, nothing new.
Complacency KILLS
(Hurts, too!)

applied this lesson to the current situation and came up with the idea of an aviation seminar within the squadron aimed directly at maximum participation of the pilots and the first line supervisors.

Each officer and supervisor was assigned to one of these discussion groups on a master roster. The discussion group assigned always coincided with the individual's area of most immediate concern and was also the area in which he could be expected to make the most vital contribution. A hard charging LT or LTJG with a broad background in his particular area was chosen to serve as chairman of each discussion group. The department heads and more senior officers were segregated from the troops and attended the policy and doctrine review session under the eyes of the XO. Major categories for discussion had to be chosen and of necessity were quite broad since this unit was a composite squadron with a wide variety of aircraft, and missions assigned. The discussion categories selected were C-54/Transport operations; S-2/Tractor operations; C-45/Photo operations; P-2/Air Launched Target operations; Anti-Submarine Drone operations; Ground Maintenance and Industrial Safety; Powered Target operations; and Squadron Doctrine and Policy Review. Many more areas could have been added but these were considered to be the primary areas.

The search then commenced for vital agenda items for each discussion group. Each group leader was informed of his chairmanship and subject and he was charged to his mission by the CO. Several days before the seminar, a joint meeting was held in the skipper's office with all the chairmen in attendance. All agenda items were mentioned and coordinative action occurred to prevent useless duplications. The agenda items for each discussion group were then handed to the Safety Officer for publication.

The morning of the seminar dawned with not the sound of a single aircraft in motion. As each officer and supervisor entered the conference room, he was handed a brochure telling him: (1) to what group he was assigned, (2) who his discussion leader was, (3) where to meet for his committee session and (4) listing his group's proposed agenda items. The safety officer had obtained the most recent color movie on aviation safety and this was shown while the members were pouring a cup of coffee and settling comfortably to seat.

Following the movie, the skipper briefed the seminar assembly on the mission of the seminar and what he hoped it would accomplish in accident prevention. All hands were advised that the successful outcome of the seminar in achieving its goals depended on the participation of each person present.

The assembly then broke up into its component discussion groups and commenced their review of the proposed subjects. In the give-and-take of full fledged discussion, these planned agenda items were soon dealt with and even more vital subjects were broached. The two and one-half hours allotted for the committee session proved to be entirely inadequate as measured by the great interest expressed. The discussions were uninhibited, frank and even heated at times, perhaps due to the fact that they were on a man-to-man basis out from under the sometimes dominating guidance of the squadron's senior officers. Each chairman was responsible for codifying the ideas, problems and hazards discovered in the group sessions.

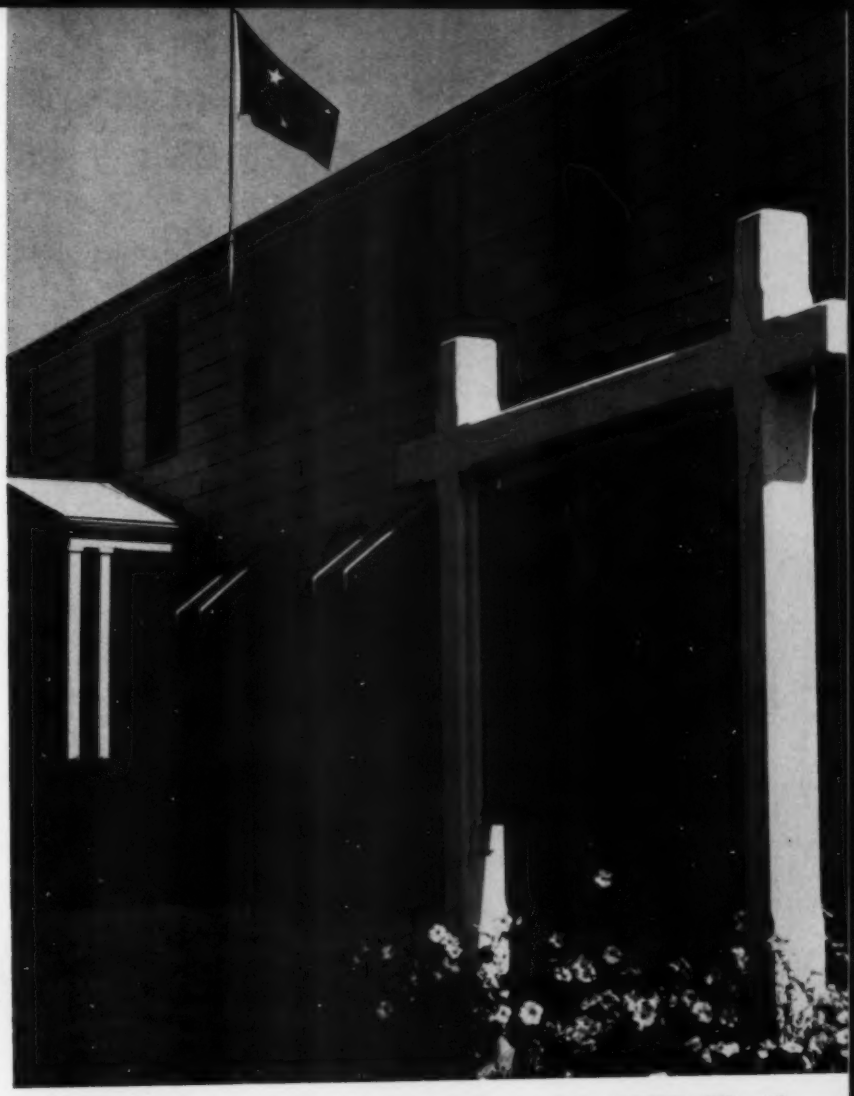
Late in the morning the individual groups came together once again in joint assembly for a presentation of each committee's findings and recommendations. Again time proved to be inadequate to cover all the ideas, proposals and hazards, which had been uncovered in the span of allotted time.

Once again the CO took over for the summary portion of the seminar. He stated that not only had we accomplished the mission of exploring the numerous problem areas of aviation safety within our squadron but we had reached an even more important objective. By this joint effort all 65 officers and supervisors were once again thinking, speaking and acting for aviation safety. We were no longer complacent when we recognized the enormity of the safety tasks yet to be done.

The CO further directed that each recommended item developed by the committees be submitted by the chairman, to the aviation safety officer for inclusion in the final report of the seminar. Each item was to be defined with: (1) a clear statement of the problem, (2) a paragraph of discussion containing the who, why, what, when and where of the matter, (3) a recommendation for action, (4) a proposed action officer, and, (5) an action due date. Following the CO's close scrutiny of each item and the insertion of his comments or directions, the report was assembled and a copy provided for each officer and shop supervisor. Follow-up procedures have been initiated by the Executive Officer to insure that each worthwhile seminar recommendation receives the attention and action that it deserves.

The safety seminar idea has 'caught on' in this squadron. It remains yet to be seen if the enthusiasm and interest generated by this one-half day's safety 'speak-in' can be directed into solid safety accomplishment. But all hands are in recognition of the fact that if solid safety accomplishment isn't our end result, it's our own collective fault because we *do not know* what the problems are.

A Profile



NAVAVNSAFECEN

By MAJ R.A. Bonney, USMC, ASO, MAG-36

A World War II wooden barracks at NAS Norfolk houses a dragon with an evil, all-seeing eye. This dragon is the guardian of the Navy and Marine Corps Aviation Safety Program. It is an omnipotent tyrant waiting for its slaves to err so it may ridicule, criticize and punish. If you don't believe it, ask any Naval Aviator. The name of this dragon is the Naval Aviation Safety Center. It is a Naval Organization composed of people; Naval Officers, Marine

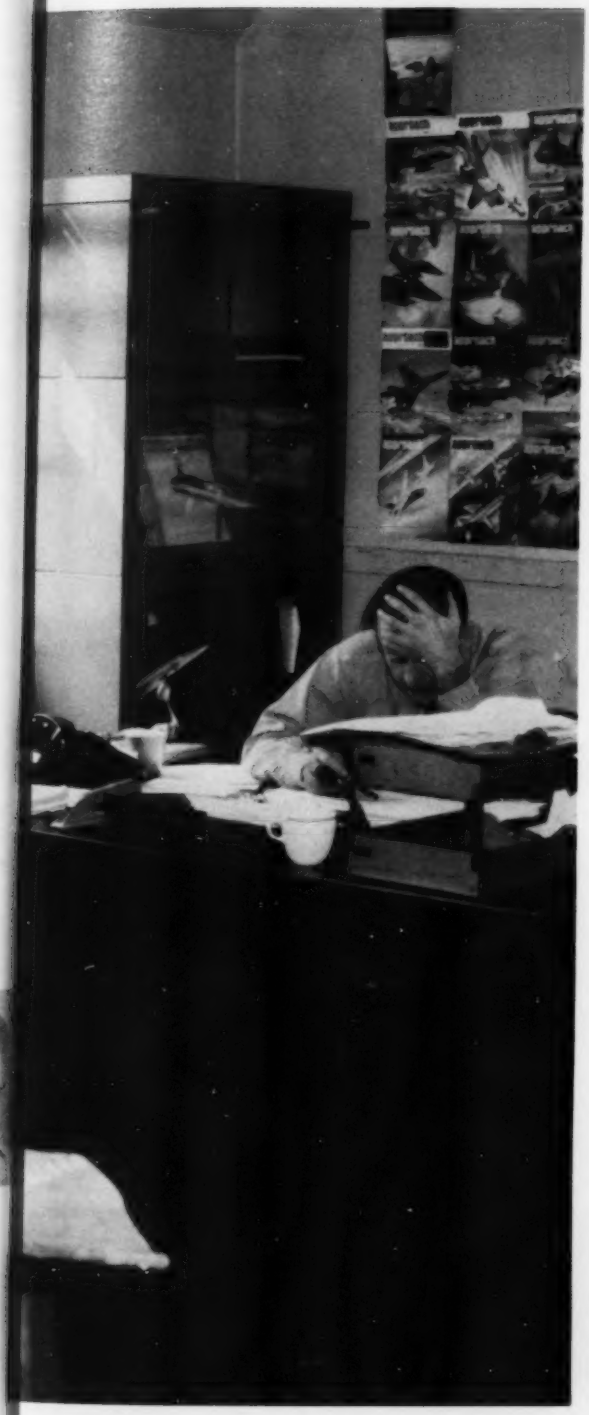
Our product is safety, our process is education and our profit is measured in the preservation of lives and equipment and increased mission readiness.

Officers, Navy and Marine Enlisted as well as civilians.

They came from somewhere in Naval and Marine aviation. Some like their job—some do not. Some are volunteers—some are there merely because they were ordered there.

The civilians may or may not have military backgrounds. All these people are either married or single with large families or small. They are a homogeneous group that contains that well known two percent. They are human with human abilities and human frailties and when their tour at NavAvnSafeCen is finished they will turn to other assignments just as you will when yours is finished.

Their goal is to learn what causes accidents and to pass on their knowledge. They know that no one



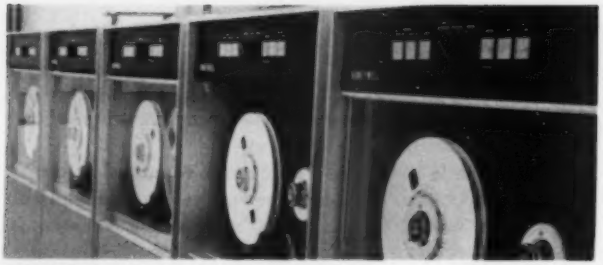
wants to break an airplane or kill himself and that the only reason this is done is because of a lack of knowledge, a lack of introspection, or disregard resulting from a lack of true comprehension of the consequences.

Keep in mind that the Center is composed of people who you know or have known, the same people with their good and bad points that you have seen in your every friend in aviation. Keep this in mind along with the success and failures that you have observed in every military organization and then observe with me what they are trying to accomplish and how.

First let me explain the Center's position in the Naval structure. The Center works for CNO and answers directly to DCNO for Air. There is no complicated organizational structure. The Center is authorized direct communication (not especially via the chain of command) with every organization and individual within the Navy and Marine Corps. This may be done by telephone, letter or message. It is authorized direct communication with the Army, the Air Force, with manufacturers, FAA, civilian safety agencies and others too numerous to tabulate. The purpose of this ease of communication then is to acquire information useful in accident prevention. The information is then sifted, consolidated, put in potable form and passed on to those who want it. Notice I said those who *want* it. *Frequently those who need it don't want it.*

There are many, many instances each year of accidents happening to people because they were not informed while at the same time the information was almost thrust upon them. How can you teach someone who does not want to learn? The Center is faced with this as the largest problem. There are those who believe that if you put it on paper everyone will understand and comply. It just isn't so. The only way to effectively educate is to first motivate the recipient. Unfortunately no one, the Center included, has been able to motivate everyone that needs to be.

Take your own experience as an example. Remember the Center is composed of folks like yourself. Now ask yourself how often you have failed to get someone really actively interested in a program, that in your view, is obviously the greatest thing since sliced bread. Difficult isn't it? The Center has the same problem. At any rate the means for direct communication is there and it works both ways. Every individual to whom the Center may communicate may also initiate communication either officially through channels or by way of the Anymouse form. Unfortunately



maximum value is not obtained from these communications.

So much for the Center's position in the chain of command and its ability to communicate.

Next, why and what about Accident Reports?

It may come as a surprise to some of you that the Center does not care a fig about who personally had or caused an accident. The Center *does* want to know why that individual had the accident and why others like him had accidents. When an accident is called pilot error the point is not that the pilot erred, but why did he? The Center knows that pilots don't deliberately try to wreck airplanes. There are circumstances of environment, attitude, physical factors, etc. that place the pilot in a vulnerable position.

One of the factors might have been that he didn't know because he didn't really feel the need to. We get back to motivation again. At any rate, as much information about each accident as is possible is collected. All the evident causes are catalogued. The

Additional Information

For a more complete picture of the functions of the Naval Aviation Safety Center, and how it affects you, review of the following films is recommended:

Safety Is Your Business
MN 10003A

The Big Payoff
MN 10003B

The Oblong Window
MN 10003C

apparent causes are compared, the types of accidents are compared, hidden causes are ferreted out and finally recommendations go to suitable agencies in the naval aviation organization. Notice the word is recommendation. The Center does not tell anyone to do anything except report honestly. The Center *does* make decisions about what apparently caused an accident i.e., Pilot, Material, Other Personnel, etc. This is done only to make it possible to categorize accidents. They may want to know why a high number of accidents are caused by pilots within a certain age group in a particular theater of operations for instance. Since these factors are catalogued the accident reports may be selected and then reviewed without going through every accident that has ever occurred.

A second reason for assigning cause factors is to use all the information supplied by the report and endorsers to let everyone concerned know the final decision for record keeping purposes.

A third reason is for purely statistical purposes. The Center standardizes findings so that when ac-

Continued

cident rates are used they are based on a single standard which makes statistical analysis meaningful.

Safety Center Organization

It is very similar to others you have known. It is organized as follows:

The liaison officers are responsible for interchange of information between other military services or FAA where common problems exist.

Aero Med monitors the Medical Officer's Report and analyzes the physical and psychological factors of an accident.

The department also has cognizance of survival equipment and monitors ejection seat problems.

Safety Education is primarily responsible for making sure timely information is available to the pilot and the rest of the Naval Establishment.

Maintenance & Material analyzes accidents for material or maintenance personnel failures.

Accident Investigation investigates selected accidents where there is a series of unsolved accidents or where there may be special interest because of a large number of fatalities, or when civilians or VIPs are involved.

Records and Statistics does all the bookkeeping on

AARs which includes coding them for a computer.

Analysis & Research acts as the operations department. The other departments assist it, with their specialized knowledge, in trying to determine accident causes and thereby discover ways to prevent accidents. The department consists of Heavy Attack, Light Attack, Heavy Multi-Engine, Training, ASW, Helo, Fighter and Facilities aircraft analysts.

Information is fed to each of these analysts by each of the departments thereby assisting the individual analyst in making recommendations to the commander for reducing accident causes. The analysts themselves range in rank from Lt/Capt to Cdr/LtCol and have recently come from operational units of their specialty. They are pilots just like you and me.

Nothing more, nothing less.

So you see in essence the Center is very much like every other naval organization that you have ever known. The organization is familiar, the people are familiar and their job is to collect information *you* and others like you supply. It consolidates the information and in turn gives it back to each of you in a usable form, so *if* you are motivated, it is there for your use.

The Safety Center then isn't the terrible dragon after all. It's just a familiar organization staffed by an ordinary bunch of guys who are trying to find out why we have accidents. When they find out they tell you. It's up to you to use what they learn.

A THIRD DIMENSION IN

On a night takeoff from a west coast air station, a transport crashed into terrain 720 ft above field elevation approximately 4 miles from the end of the runway, resulting in loss of all persons on board. This fatal accident was set up by a lack of effective communication between the pilot and the air traffic controller. The pilot apparently was expecting a radar vectored departure while the controller was expecting the pilot to follow the issued clearance including a left turn at two miles.

This accident could have been avoided by use of, and adherence to, the appropriate Standard Instrument Departure—better known as a SID. Although use of the appropriate SID would have saved this aircraft, there has been some criticism of SIDs in the past because of their failure to assure a pilot of clearance over obstructions along his course. To remedy this, the Air Force and the Navy have established an obstruction clearance criteria and are now including on SID charts (where required by the criteria) a minimum rate of climb which will assure a pilot clearance over obstructions along his departure route, giving him a "third dimension" in flight safety.

SID charts, like instrument approach procedure charts, started as a rather unsophisticated tool and had a single purpose—to simplify the execution of prescribed maneuvers under IFR conditions. They still serve this purpose, but they also satisfy many other objectives. SID charts provided a graphic presentation and a textual description of an Air Traffic Control (ATC) departure clearance, designed to get the pilot from the runway to a specific fix on the Airway/Jet Route structure. They serve to increase the safety and efficiency of terminal area flight

DEPARTURES

By Jack C. Edmister, Air Information Specialist U. S. Naval Oceanographic Office.

operations, minimize the possibility of misunderstanding a clearance, and reduce pilot/controller workload. SIDs reduce delays and communications in the movement of aircraft from the takeoff position to the Airway/Jet route structure, providing a safe, rapid departure, and to the extent possible, a route that avoids flight over or near hazardous terrain and man-made obstructions. The receipt of departure clearances containing routing and altitudes other than that planned and filed is minimized; pilots experiencing lost communications have in their hands an approved flight plan and clearance; and lastly, for those fields located in heavily populated areas, SIDs can generally be designed to support noise abatement programs.

In developing a SID procedure for a Naval Air Station, operations personnel will review the clearances issued in the past to the majority of departing aircraft, and propose routes to satisfy the requirements of this traffic, taking into account both local and transient traffic, nearby or overlying Airways/Jet Routes, and surrounding terrain. Proposed SIDs are then coordinated locally, for release of airspace, with FAA and other military airfields in the area; then forwarded to the Naval Oceanographic Office for review and approval. Coordination may require give and take on the part of all parties to work out crossing altitudes of Airway/Jet Route segments and even of the SID routing itself. The resulting SID specifies courses, distance, and now with the third dimension, will include where required, a minimum rate of climb, expressed in feet-per-minute, which will assure clearance of all obstructions along the prescribed route. (See Figs. 1 and 2.)

Commanders of Naval and Marine Corps air activi-

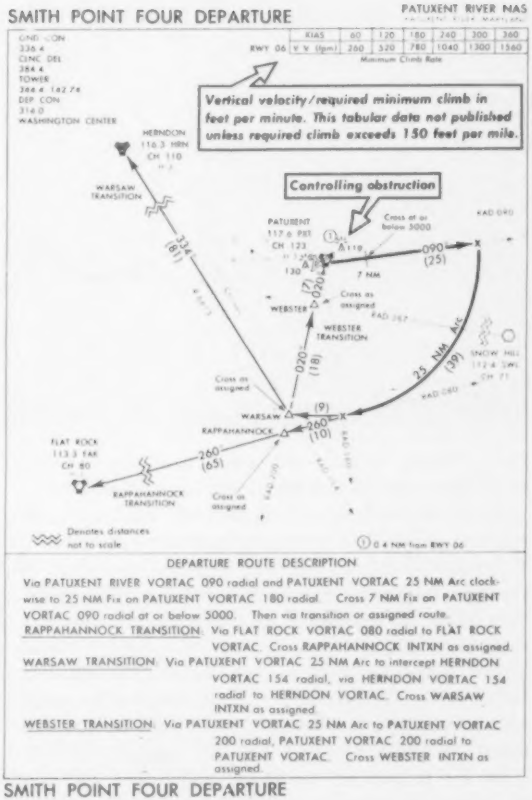

SMITH POINT FOUR DEPARTURE
PATUXENT RIVER NAS
RWY 06
KIAS 60 120 180 240 300 360
V S (fpm) 260 520 780 1040 1300 1560
Minimum Climb Rate
Vertical velocity/required minimum climb in feet per minute. This tabular data not published unless required climb exceeds 150 feet per mile.
Controlling obstruction
HERNDON
WARSAW TRANSITION
PATUXENT
WEBSTER
WEBSTER TRANSITION
WARSAW
RAPPAHANNOCK
FLAT ROCK
RAPPAHANNOCK TRANSITION
25 NM Arc
7 NM
Cross at or below 3000
Cross as assigned
Denotes distances not to scale
DEPARTURE ROUTE DESCRIPTION
Via PATUXENT RIVER VORTAC 090 radial and PATUXENT VORTAC 25 NM Arc clockwise to 25 NM Fix on PATUXENT VORTAC 180 radial. Cross 7 NM Fix on PATUXENT VORTAC 090 radial at or below 5000. Then via transition or assigned route.
RAPPAHANNOCK TRANSITION: Via FLAT ROCK VORTAC 080 radial to FLAT ROCK VORTAC. Cross RAPPAHANNOCK INTXN as assigned.
WARSAW TRANSITION: Via PATUXENT VORTAC 25 NM Arc to intercept HERNDON VORTAC 154 radial, via HERNDON VORTAC 154 radial to HERNDON VORTAC. Cross WARSAW INTXN as assigned.
WEBSTER TRANSITION: Via PATUXENT VORTAC 25 NM Arc to PATUXENT VORTAC 200 radial, PATUXENT VORTAC 200 radial to PATUXENT VORTAC. Cross WEBSTER INTXN as assigned.
SMITH POINT FOUR DEPARTURE

FIGURE 1

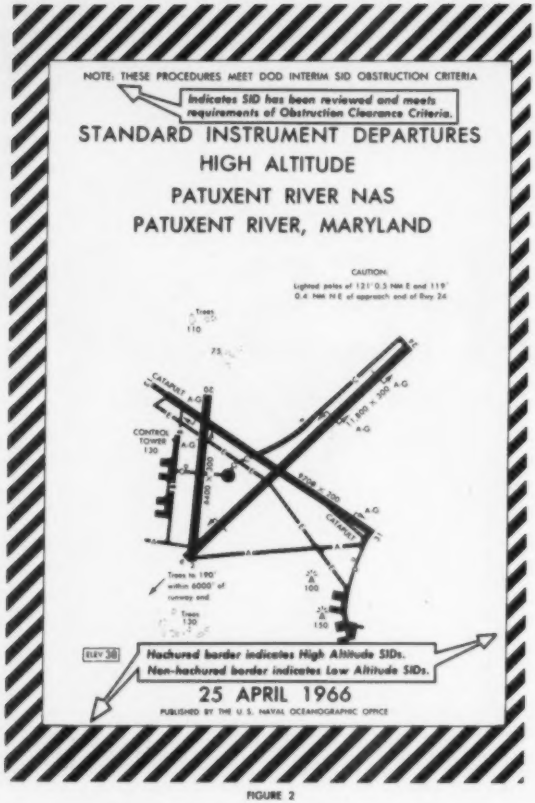

NOTE: THESE PROCEDURES MEET DOD INTERIM SID OBSTRUCTION CRITERIA
Indicates SID has been reviewed and meets requirements of Obstruction Clearance Criteria.
STANDARD INSTRUMENT DEPARTURES
HIGH ALTITUDE
PATUXENT RIVER NAS
PATUXENT RIVER, MARYLAND
CAUTION:
Lighted poles of 121° 0.5 NM E and 119° 0.4 NM N E of approach end of Rwy 24
Trees 110
75
CATAPULT A.G.
CONTROL TOWER 130
A.G.
1,800 x 300
A.G.
2,800 x 300
A.G.
Trees to 190' within 6000' of runway end
Trees 130
A 100
A 150
Hachured border indicates High Altitude SIDs.
Non-hachured border indicates Low Altitude SIDs.
25 APRIL 1966
PUBLISHED BY THE U.S. NAVAL OCEANOGRAPHIC OFFICE

FIGURE 2

ties have the responsibility of determining if SIDs are necessary at their fields, taking into consideration the needs of both local and transient traffic and ATC requirements. Establishment of SIDs at Air Force aerodromes is mandatory regardless of the simplicity or complexity of local ATC departure clearances.

At those fields where SIDs are established, you will not always find them available for every desired departure route, but you will find that they exist for the most frequently used routes and to satisfy specific operational requirements. At some fields, SIDs have been developed requiring only the use of tacan. These SIDs have been developed primarily for tacan only equipped aircraft and do not include any reference to low frequency or VOR navigational aids.

In the interest of simplicity and safety, the number of navigational aids and crossing altitudes/flight levels incorporated in a SID is kept to a minimum. In establishing and coordinating these crossing altitudes/flight levels with FAA, consideration is given to the performance of all aircraft authorized to use the SID.

SIDs are usually named after a geographic location or a navigational aid along their routes. When established, a SID is given a name and designated as number "one"; for example, "Richford One Departure." When a SID is revised, it is renumbered, using the next number in sequence; for example, "Richford Two Departure." Two SIDs for the same airfield or for fields located within the same general areas are not given the same or similar names. For example, "Alley Oop One" and "Alley Cat One" would not be used to designate departures at the same or nearby fields.

A SID will include but one departure route, however it is permissible to include multiple transition routes which emanate from the terminating fix of the basic SID route. The transition routes terminate at a specified fix on the appropriate en route structure (airway or jet route). Transition routes are generally named for the navigational aid at which they terminate or for a geographic location along the route of the transition.

A SID gives a pilot an inherent advantage over a radar controlled (vectored) departure simply because in the approval of a SID, a prescribed area is reviewed and considered for obstruction clearance and, where required, minimum rates of climb are included on the chart. On a radar vectored departure, the controller, of course, has knowledge of the highest obstructions in his area of coverage, but the review and establishment of climb rates for each possible vector is not practicable.

The Federal Aviation Agency (FAA) and the Department of Defense (DOD) are in the process of developing common specifications for the production of SIDs. Meanwhile, the Navy and Air Force are producing SIDs to common USAF/USN specifications.

Prior to January of this year, there was no estab-

OBSTRUCTION CLEARANCE AREAS WHEN A SID TURN IS 15° OR LESS

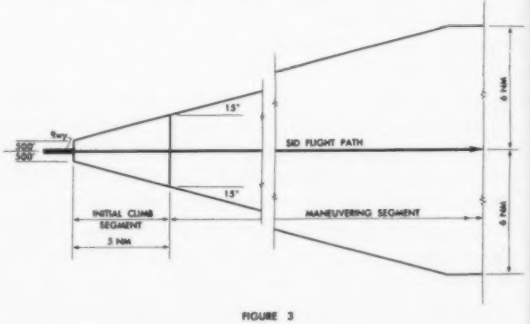


FIGURE 3

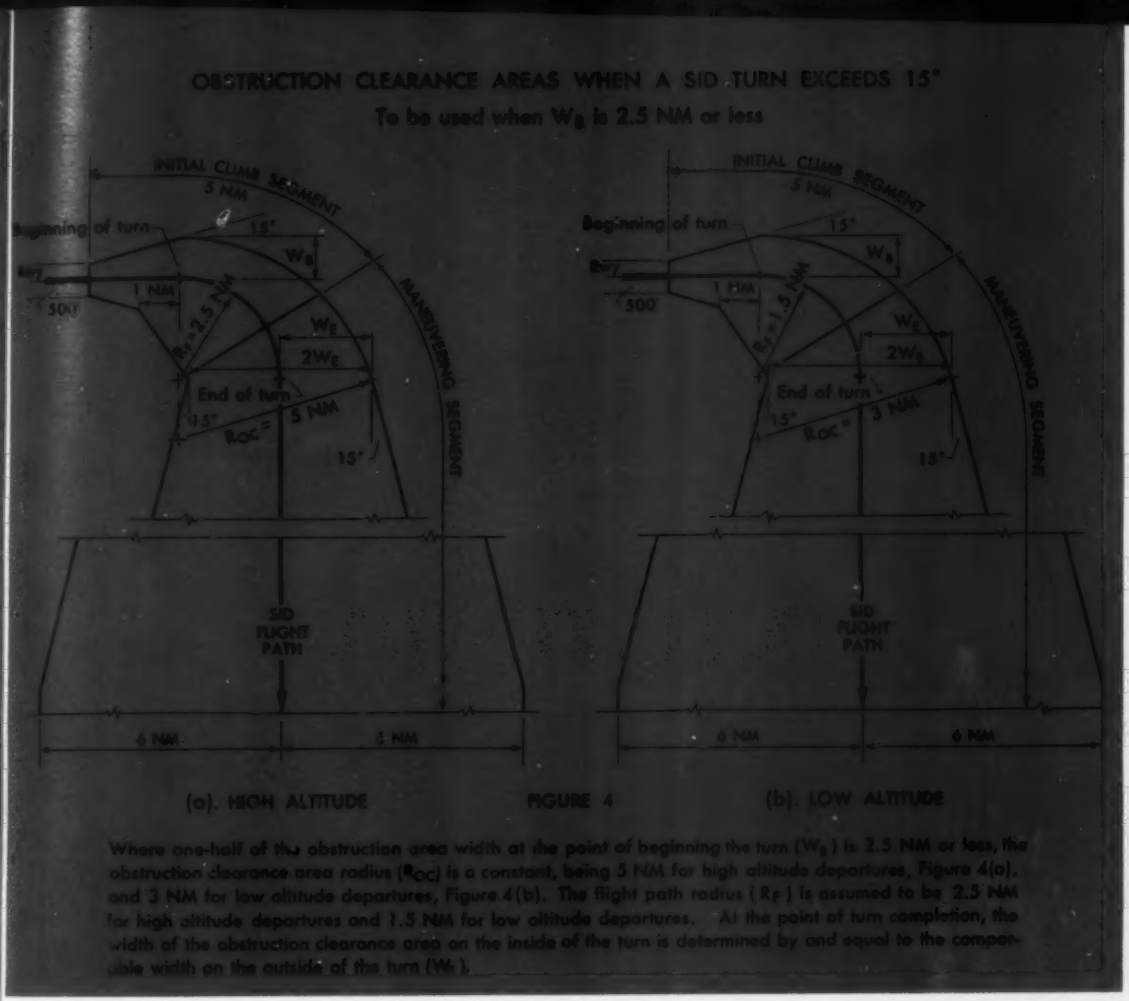


FIGURE 4

Where one-half of the obstruction area width at the point of beginning the turn (W_B) is 2.5 NM or less, the obstruction clearance area radius (R_{OC}) is a constant, being 5 NM for high altitude departures, Figure 4(a), and 3 NM for low altitude departures, Figure 4(b). The flight path radius (R_F) is assumed to be 2.5 NM for high altitude departures and 1.5 NM for low altitude departures. At the point of turn completion, the width of the obstruction clearance area on the inside of the turn is determined by and equal to the comparable width on the outside of the turn (W_E).

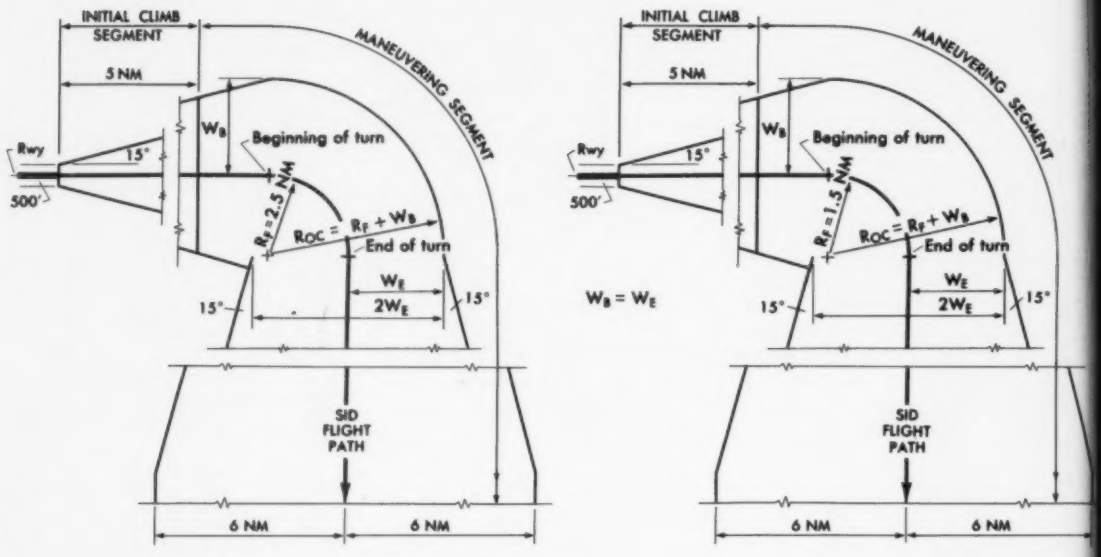
lished criteria to determine whether adequate obstruction clearance was provided on Standard Instrument Departure procedures. To remedy this situation, the Navy and the Air Force have formulated and implemented interim SID obstruction clearance criteria. The two services are currently reviewing both existing and new procedures for conformance with this interim criteria. The area considered for obstruction clearance is as indicated in Figs. 3 through 5. This area is divided into two segments, the initial climb segment and the maneuvering segment.

The initial climb segment begins at the far end of the takeoff runway and has a width of 500 ft each side of the runway center line. It is five miles in length and except in turns of more than 15°, expands uniformly on each side of the flight path, (see Fig. 3.) along a line making an angle of 15° with the extension of the runway center line.

The maneuvering segment begins at the point where the initial climb segment ends and extends to the point where the SID flight path joins the Airway/Jet route structure. It expands uniformly in width from the width at the five-mile point of the initial climb segment at the same rate as for the initial climb segment (except in turns exceeding 15°) until it attains a total width of 12 miles. If positive course guidance (flight defined by the electronic signal of a navigational aid) is provided, the total width of 12 miles (six miles each side of the flight path) remains constant. If positive course guidance is not provided, this area continues to expand at the same rate until the Airway/Jet route structure is reached or until positive course guidance is provided. (See Fig. 3.)

In turns exceeding 15° the obstruction clearance area radius (Roc) for the turning maneuver is de-

OBSTRUCTION CLEARANCE AREAS WHEN A SID TURN EXCEEDS 15°
To be used when W_B is more than 2.5 NM



(a). HIGH ALTITUDE

(b). LOW ALTITUDE

Where one-half of the obstruction area width at the point of beginning the turn (W_B) is more than 2.5 NM, the obstruction clearance area radius (R_{OC}) is equal to the sum of the flight path radius (R_F) and W_B. The radius R_F is assumed to be 2.5 NM for high altitude departures, Figure 5(a), and 1.5 NM for low altitude departures, Figure 5(b). For example, in Figure 5(a), if W_B is 3.4 NM, add the constant R_F of 2.5 NM to W_B giving an R_{OC} of 5.9 NM. At the point of turn completion, the width of the obstruction clearance area on the inside of the turn is determined by and equal to the comparable width on the outside of the turn (W_E).

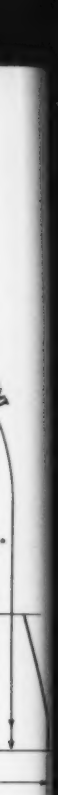
FIGURE 5

termined from the diagrams in Figs. 4 and 5. After the turn is completed, the 15° rate of expansion for obstruction area consideration is resumed as indicated in Figs. 4 and 5. At the point of turn completion, the width of the obstruction clearance area on the inside of the turn is determined by and equal to the comparable width on the outside of the turn (WE).

When the lateral area of consideration has been determined, the criteria provides for the identification of the controlling obstruction in this area and the establishment of a minimum rate of climb that will assure the required obstruction clearance as explained by Fig. 6.

Under the new criteria a rate of climb is published on all SIDs when the minimum rate of climb exceeds 150 ft per mile. SIDs with a minimum climb rate greater than 300 ft per mile may be established only with special authorization. For publication purposes, this rate of climb is converted to feet per minute and tabulated on the SID as a vertical velocity (V/V) in 60 kt increments of indicated airspeed ranging from 60 to 240 kts for low altitude charts and from 60 to 360 kts for high altitude charts. (See Fig. 1).

We suggest that you try the new improved SID, with the exclusive third dimension additive. You will find it faster, safer, and more efficient than ever before. Keep a SID package on hand and use it at the first sign of departure congestion. Remember, it has the Good Flight Keeping seal of approval.



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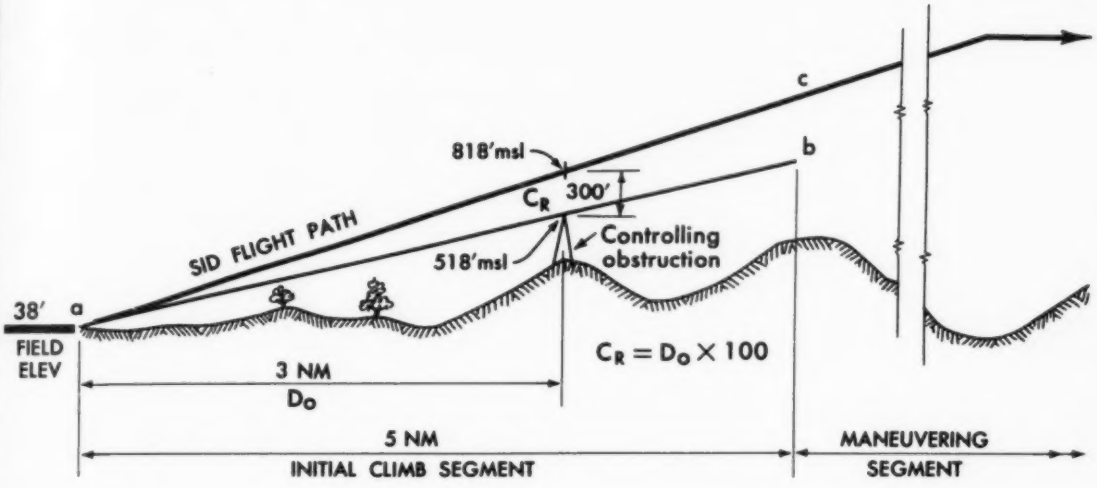
IDENTIFICATION OF A CONTROLLING OBSTRUCTION AND COMPUTATION OF A MINIMUM RATE OF CLIMB



1. In the identification of a controlling obstruction and the computation of a minimum rate of climb, critical obstructions in the initial climb segment are plotted and a line ab is drawn from the end of the runway to the top of the controlling obstruction.

2. The clearance required (C_R) over the controlling obstruction increases directly with the distance (D_O) of the obstruction location from the end of the runway at the rate of 100 feet per nautical mile. Thus, $C_R = D_O \times 100$. This clearance when added to the controlling obstruction elevation determines a point on the tentative required minimum flight path, line ac. In the figure above, the distance of 3 NM $\times$ 100 gives a C_R of 300 feet which when added to the obstruction elevation of 518 feet determines the point 818 feet msl on the tentative flight path, line ac. Subtracting the field elevation of 38 feet from the 818 feet at the 3 NM flight path point gives a required rate of climb of 780 feet in 3 NM or 260 feet per mile.

3. This tentative SID minimum flight path becomes final only when it has been determined that it also provides 500 feet of clearance over all obstructions in the maneuvering segment out to the point where this segment reaches a total width of 12 NM. Outward from this point, clearance of 1000 feet must be provided. If the tentative minimum flight path does not provide required clearance over all obstructions in the maneuvering segment, it must be adjusted upward as necessary.

FIGURE 6

SAFETY is for STOOF DRIVERS, too...

By LT B. O. Deaton, ASW Training Officer, NAAS Grosse Isle

Every time someone tells me how simple and easy the S-2 is to fly, I'm reminded of a good friend who once told me, "You can't get hurt in a *Stoof*—it's too slow and too easy to handle." A few days later, he and three other friends dug a small hole in the ground with the blunt end of an S-2. This aircraft *is* simple and easy to fly, but it can get complicated and difficult at times.

A review of all S-2 accidents between January 1954 and September 1966 reveals a few surprises. All of us who have really gotten to know the bird look upon it as one of the best ever. But the record shows that many good airmen have been fatally trapped by its very goodness.

There have been a few (very few) accidents in its history which would be commonly referred to as unavoidable. These are not the accidents that disturb me. The aircraft has no unusually vile characteristics and no abnormal tendencies to bedevil pilots . . . it doesn't blow up in midair, shed wings for no apparent reason, or any other such devilish things. In fact, you will hear it most usually referred to as "A good, honest and forgiving machine—a gentleman's aircraft," which is pretty close to the truth. The aircraft is deserving of the love and trust pilots tend to put in her. However, this general feeling of security can bring on that old false sense of you know what. Security is not always there.

Stoof drivers everywhere will expound on its excellent single-engine performance data. I'll not disagree with these proven assets. It *is* a good single-engine performer—*If*—and this is the point, *If* properly handled in single-engine situations. The records show that an unusually high percentage of all fatal S-2 accidents have been as a result of engine failures. This is tragic, as well as unreasonable, since the accident rate due to engine failures should be *zero* (discounting the occasional simultaneous engine failure and cold cat shot). The fact that the bird has a reputation for performing very admirably on one good engine has led more than one pilot into disaster through his failure to realize the absolute necessity of prompt and proper single-engine procedures.

Some situations in point are:

Loss of an engine at or below 100 kts IAS, if not properly handled, will result in an accident.

Loss of an engine on takeoff with full bomb-bay

tank (or at max gross weight), if not promptly and properly handled, will result in an accident. A field elevation above sea level will considerably aggravate the situation.

Loss of an engine in IFR conditions and with moderate icing, if not properly handled, will probably result in an accident. This aircraft will *not* maintain altitude on one engine with any significant amount of structural ice.

The solutions to the above situations are, in many cases, obvious.

Don't fly at or below 100 kts IAS except when necessary, such as landings or practice approaches to stalls.

With a full bomb-bay tank or at high gross weights and/or takeoffs from high elevation fields, don't feel that you have to liftoff at 100 kts. Hold it on the deck until 110 kts or so and then lift off. If one fails —wings level, ball in the center, gear up, and feather the prop on the failed engine. At 115 kts it will be no big problem. At 100 kts it will be five times as hard to keep it in the air. If you try to make a turn, or let a skid develop, or fail to raise the gear and feather the prop, you have nowhere to go but down. Properly handled without hesitation, you will be able to climb and accelerate to a safe speed and altitude for a return to a landing. That extra 10-15 kts for liftoff will be worth a million dollars.

If you are in icing conditions and lose an engine, don't try to make it go the route. Land at the nearest suitable field. Remember, the aircraft will not maintain altitude, even at sea level, with one engine feathered and a load of ice. Any time you are cruising in icing conditions, especially over high terrain, have an emergency landing field in mind—and not too far away, either. A controlled, slow descent can be managed, but descend you must.

How many times have we had a d.c. generator go out on us on an IFR cross-country, with the weather anything but good with a touch of ice in the air, and elected to continue to our destination—or even took off on another leg? Once is too often. If you're so adventurous to want to fly on instruments, partial

panel with no nav aids, unable to maintain altitude (with no altimeter indication) and unable to de-ice (and possibly unable to use alternate air), no lights, no radios, no trim tabs, over unfamiliar terrain, all on one fan—you can set yourself up for it easily by just flying with one d.c. generator out. All you have to do is lose the engine with the other d.c. generator. Even with both engines turning, a failure of the other generator would give you plenty of problems, but with an engine failure it rapidly degenerates into a "step out and walk" situation. The solution is again obvious. If you lose one of your d.c. generators, get down and get it fixed.

These are a few things to think about if you happen to squire the *Stoof* about the countryside. There are many more, also. She's a good bird but don't be fooled into thinking it will fly like a charm every time you hop in it. Don't be trapped into a false sense of security by its single-engine performance when the bird is relatively light on a fam hop. There are times and places where single-engine performance goes to pot.

Safety is like the weather—you can get everybody to talk about it but sometimes no one does much about it. Here's one thing you S-2 drivers can do about it. Practice your single-engine procedures. Practice them more than just once a year for your NATOPS check. And when you do practice them, don't just let the button pop out and call for the restart check list. Fly it around for a while—get the feel of the plane—feel adventurous. Try it with the gear and flaps down. You'd have to get them down for a landing anyhow, if you had to punch one out, so why not learn about it now instead of when you're all shook up. It won't hurt the engine to cool off as long as you follow the proper warm-up procedures after restart. You will be surprised how much smoother it is the next time you feather one, and the next time might be a real emergency. Why not try a single engine in the soup sometimes. You don't have to feather one—just pull one back and see what happens. You will be surprised how much more difficult it is. Besides, your check pilot will probably give you an *engine out* on your next instrument check. And how about that you instrument check pilots? Give one lately? How about trying one at night? There's nothing in the GREB to indicate that these engines go out only in the daytime.

There is nothing like actually doing something to increase your proficiency. And simulation is the next best thing. We all need practice—and with the practice will come proficiency. Remember, the S-2 accident rate due to engine failure, proficiently handled should be *zero*. Let's put it there.

TEXAS TOWERS

No piece of cake!

By LT John L. Abrams, SAR Unit, NAVSTA Bermuda

The Office of Naval Research operates an offshore "Texas Tower" located 35 miles southwest of Bermuda. It is supported logistically by the Naval Station, Bermuda, utilizing the local command's UH-34J. Though this is the only Navy tower in the vicinity, there are many such towers scattered along the Gulf coast of the United States, that, in an emergency situation, Naval helicopter pilots may be called to land upon.

To a carrier helo pilot, the prospect of landing aboard a Texas Tower appears to be a piece of cake; a piece of cake that consists of ground glass and many other dangers if all aspects of the situation are not analyzed.

The first point to be noted is that the towers usually have a deck area of 85 ft square with a clear landing area of approximately 85 by 50 ft. These dimensions afford approaches from only two directions. As towers have not been known to turn into the wind, open sea crosswinds of 60 to 90 degrees and winds of 30 kts

". . . at an altitude of 15 to 30 ft higher than the deck level, transition to a near hover . . . ."

"... a portable scale to be hung from the rescue hoist to weigh cargo . . . ."

". . . rotor speed up . . . to prevent sharp gusts from dipping the tip path plane . . . ."

or better, are not uncommon.

The crosswind component, combined with a high density altitude plus operations at or near max gross weight, can make for some uncomfortable situations.

The 35-foot area which is not available for landing is usually filled with an odd assortment of whip antennas, cable stores, miscellaneous crates, fuel tanks, and a large movable boom crane. As space is critical, these obstructions are placed so as to allow *just* rotor clearance.

As with any flight, planning requires attention to detail. Fuel loading should be light enough to permit adequate payload, yet substantial enough to ensure safe reserve for the return flight. Haphazard cargo loading can be fatal, therefore, a portable scale is hung from the rescue hoist to weigh cargo before it is brought aboard. This weigh-in is essential to permit the quoted weights of groceries, supplies, etc. These weights are often grossly underestimated.

Out-of-ground-effect hovering tables should be consulted to determine maximum gross weights allowable for the specific conditions. After the aircraft is loaded, but prior to departure, a test hover with the same relative wind expected at the tower is advised to ensure that adequate power is, in fact, available. The crew should be thoroughly briefed and prepared to keep the pilot advised of his tail wheel position in reference to the deck edge at all times.

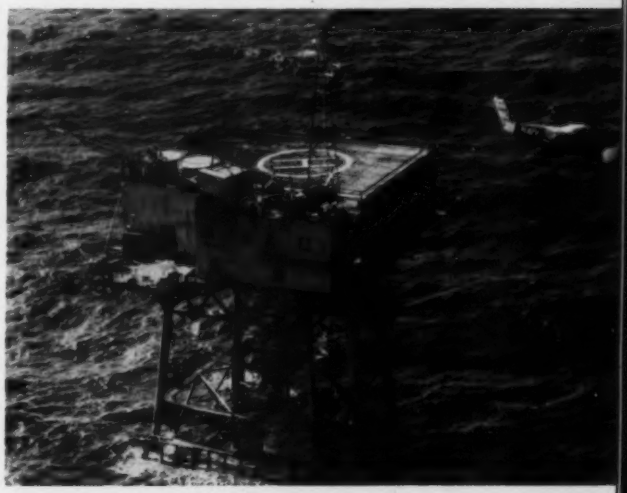
Upon arrival at the tower, a recognition pass is recommended to reaffirm that the landing area is clear and ready. Landing signal personnel are rarely available, so the entire operation must be coordinated effort between the cockpit and the after station.

When satisfied that the deck is clear and after coming into the wind (as close to the wind as possible) an approach designed to undershoot the tower by 150-200 ft should be initiated. Prior to reaching the tower, at an altitude 15 to 20 ft higher than the deck level, transition to a near hover should be completed. This allows the pilot clear view of the deck at all times, and complete control of all relative motion. This also allows a "way out" when unforseen events such as power settling occur.

The landing itself should be made vertically and firmly with the brakes *locked;* the limited deck area has no taxi room. Deck edge turbulence or *burble* should be anticipated as it is always present in varying intensities, and worsens if the crosswind passes over the obstructed area of the deck.

The larger helos should keep their rotor speed up while on deck to prevent sharp gusts from dipping the tip path plane into any objects it may be overlapping. Shutting down should only be attempted after rotor clearances and relative wind parameters are deemed appropriate. Use of chocks is advisable even for short stays.

"Take off should be vertical, moving straight ahead slowly until clear of the tower."



"The altitude available may be used to advantage . . . ."

Takeoff should be vertical, moving straight ahead slowly until clear of the tower. Rotation for safety airspeed should be made as soon as practicable; the altitude available may be used to advantage to obtain translational lift if heavily loaded.

The old axiom, "expect the unexpected" is a good one to heed in this type of operation. But, by being well planned, well prepared, and well executed "Texas Tower" operations can be a good "piece of cake."

Advanced Base

By LCDR S. B. Sloane, ASO VP-8

(This article was written upon the author's completion of three months of operations in direct support of the war effort in Southeast Asia. It is a safety officer's advice to flight crews after observing problems which resulted from the nature of around-the-clock, all-weather operations.—Ed.)

A true test of any squadron's operational readiness is its ability to deploy to an advanced base of operations and carry out assigned missions successfully with neither injury to personnel nor damage to material. In many respects, advanced base operations are merely the transfer of the unit's activities to another geographic location. The flight hazards which exist at the home port are brought along as the ever present gremlins which adversely influence the performance of aircraft and personnel. To let it go at that would be a gross oversimplification, however!

To a great degree each individual, whether he realizes it or not, designs his own personal flying safety program. All hands attend the same lectures, glance at the same notes appended to the daily flight schedule, and are subjected to the same admonitions of the CO, the ASO, and the Ops Officer. In the final analysis, however, the steps necessary in the prevention of aviation mishaps are a series of individual, highly personalized actions. Each plane commander controls the planning of a flight and makes hundreds of inflight decisions which increase the probability of satisfactory mission completion; each flight crewmember performs duties which contribute to the safety of his comrades; each ground support technician, mechanic and supervisor does a job which enables the aircraft to fly effectively and return safely. The chain-of-command provides all hands with the basic tools to accomplish these jobs: policy directives, standardized procedures and training. Why then do some individuals survive thousands of hours in the air while others do not?

The answer is definitely not luck; it is a matter of the individual's receptiveness—to directives, standard procedures and training. The best safety education in the world is worthless unless motivation is present. Similarly, even the most marginal of formal safety programs will contribute to accident prevention when individuals are motivated to show serious, intelligent consideration of potential hazards.

Fortunately, when a high degree of motivation exists, it can be transferred easily to the advanced base. It then becomes necessary only for the individual to adapt to the strange new environment. This is more easily said than done. Let us re-examine some of the problems encountered in the attempt to adapt to a new environment.

The most serious obstacle is a sort of mental inertia. The results of this can be tragic when a conscientious man concentrates on old solutions for new problems and is clobbered by something as simple, say as field elevation or runway temperature.

Another very important area is that of complacency. This particular axe has a double edge and tends to swing in two directions. While operating out of our home fields, all of us become familiar with those parameters which affect safety of flight: terrain features, runway dimensions, traffic control procedures, environmental conditions and many more. This familiarity lulls the unwary into a false sense of security which can, and has, increased the taxpayer's yearly airplane bill and the pilot's monthly insurance premiums. Here the absence of stress leads to complacency.

A second aspect of this problem is more applicable to deployment and is certainly less understood. Here the tendency is to appear complacent as a result of resistance to change, fear of reality, and insecurity caused by unfamiliar surroundings. All of these factors cause a heightening of anxiety and stress which adversely affect vigilance. In an attempt to cover up his anxiety, a pilot or aircrewman may appear to become complacent. Continued

eOperations

A personal program for Readiness Through Safety.

Fatigue-producing factors are never totally absent.

In order to take steps necessary to avoid hazards, the individual must first recognize that these dangers are, in fact, real and could turn him into an unpleasant statistic. The trouble comes when the individual fails to do this because he does not want to admit to himself that he is taking different and greater risks. Not enough stress, as back in familiar territory, or too much stress, as encountered in unfamiliar surroundings, can adversely affect vigilance. With a realistic approach to danger on the part of aviation personnel, there is enough anxiety present to help us get the job done without decreasing our vigilance.

Once the hazards are recognized they can be dealt with realistically. The same formula for success that worked so well during less hectic days can be used. Applying command policy, standard procedures and training principles is the solution. Having perceived that a stepped-up pace of operations and pressing commitments tend to make all hands cut corners, the pilot or crewmember who has command of himself and the situation will conduct the most meticulous of preflight inspections, flight plannings and briefings. This planning should include a careful study of divert fields, forecast weather, alternate routes, minimum safe altitudes, takeoff computations and other factors which may not have been seriously considered since Training Command days.

Once airborne, the pilot should take steps to conduct the flight in the most professional manner with particular attention to checklists, survival equipment, primary and back-up navaids, on-station relieving procedures, the use of the copilot as a safety observer, the proper posting and rotation of lookouts, fuel management and standard operating procedures. Upon returning to that field with the too short, too narrow runways and insufficient field lighting, a careful postflight inspection will be followed by writing up aircraft discrepancies as if it were the family auto and the warranty had only 24 hours to go.

All these steps are nothing new. They are indeed part of every aviator's bag of tricks—every aviator who has not fallen victim to complacency.

Three Factors in Fatigue

Another problem area that needs study is that of fatigue. While deployed, the squadron is required to take on a heavy schedule of operational flights. Since these supplement rather than replace normal training requirements, flight hours per month are often double or triple those normally flown. These additional flight hours not only affect flying personnel but mean greatly increased hours and an irregular work schedule for the ground support types. The human machine is subjected to a much greater level of stress, both in the air and on the ground. The result of this stress is a detrimental alteration of mental and physical skills. When performance deteriorates to marginal levels, the results can be human factor accidents. Three broad categories of factors that can cause mental and physical fatigue are flight stresses, poor living habits and personal problems. All of these factors may be present on deployment.

Flight Stresses

Physical fatigue increases proportionately with flight hours. While in flight the human body is sub-

jected to many fatigue-producing parameters such as changes in barometric pressure, temperature variations, multi-directional movement, acceleration forces, noise, vibration and fumes.

In addition to these physical strains which tend to produce stress in flight, there are psychological factors which have just as fatiguing an effect on skills. For example, alternating doses of fear and boredom have a detrimental effect on performance. The degree to which these mental fatigue-producing factors affect one will vary with the individual; however, they are never totally absent. As the professional aviator gains experience, he tends to develop an immunity to some of these mental strains. But overcoming the effects of physical strain depends upon keeping physically fit and rested.

The danger comes when the pace of operations increases suddenly and significantly. The level of flight stress that the individual adapts to prior to deployment is based upon a relatively long period of recovery time. Under normal conditions, operational and training commitments are such that by the time he flies again, an aviator is fully recovered from the effects of his last flight.

On deployment, with longer and more frequent

Back in the old days anything beyond 150 miles was advanced base operations.

flights to contend with, the stress level increases. The rate of adaptation of the individual to a new set of circumstances lags behind the rate of onset of those circumstances. Therefore, it is during the early weeks of deployed operations that the greatest disparity exists between the job requirements and the individual's ability to perform that job. Measures must be taken early in the game to minimize flight stresses. The command can take certain steps here such as the careful monitoring of flight crew work load and the

A realistic and professional approach helps to get the job done.

The mature individual will attempt to objectively assess the effect of fatigue . . .

scheduling of crew rest. But without the conscientious cooperation of the individual, command efforts may be ineffectual. Scheduled crew rest, for example, is meaningless unless the time is used in the prescribed manner.

Although the individual may rapidly adapt to the increased work load, the cumulative effects of fatigue will decrease the reservoir of skills available to him and place limitations on his abilities. As his abilities become adversely affected, his self-imposed minimums must be adjusted accordingly.

Command imposed minimums are devised with a theoretical man-machine-environment relationship in mind. Published restrictions are absolute minimums designed for nearly optimum situations. There is often a fine line between getting full combat performance out of an aircraft and placing the pilot in a situation that exceeds his own personal minimums. The most capable person to program the human element into the numerous limiting factors appropriate to any given flight should be the pilot himself. No written directive can predict the proper safe minimum night operational altitude, for example, for a given pilot, at a given level of fatigue, on a given night.

Most pilots will adjust their limitations as the status of their aircraft equipment degenerates. With radar, radar altimeter, fuel quantity indicator or navaids inoperative, a pilot will alter his concept of the operational capability of the aircraft and act accordingly. He should do the same as his mental and physical condition degenerates.

It is, however, difficult, if not impossible for a pilot to accurately determine his own *status*. There are too many subjective factors involved. His own ego will make him a poor evaluator of his skills. He may be too proud to admit that he should "add a little for cushion."

The mature individual will attempt to objectively assess the effect of fatigue on his performance. He will recognize prior to and during each flight the detrimental effects of fatigue which are accumulating. In short, he knows himself and his own limitations and acts accordingly.

Living Habits

Another group of fatigue-contributing elements is that of poor living habits. These are all those acts in daily living which tend to have a degenerative effect on the general state of health. These acts are not necessarily fatigue-producing, but they do decrease the ability to resist flight stresses. Unfortunately the opportunity for allowing oneself to formulate poor living habits is more readily available away from home.

Dietary habits have a tendency to become unregulated. Eating at the club on every off-duty night may be fun but often results in overeating and obesity, especially when preceded by the old tradition of rolling dice for just one more drink. The day/night variations in flight scheduling may result in as many as five meals in one day (two airborne) and no meals the following day (fast asleep). The opportunity to develop new habits or rearrange old ones is present on deployment. Unfortunately the tendency is to do so in a manner which adversely affects one's general state of health. One does not necessarily have to transform himself into a "Jack Armstrong—The All American Boy" type. But using common sense and a little moderation in all activities through individual self discipline will alleviate this problem. Commands must place specific emphasis on some sort of physical exercise program and encourage moderation in the use of alcohol, diet, smoking, and liberty activities. Commands should also emphasize the necessity for adequate rest.

Personal Problems

The most personal and difficult to define group of stress-producing factors is in the area of personal mental hygiene. This includes all those sociological problems which tend to have adverse psychological effects on the individual. A myriad of problems on the home front find their way, via the Fleet Post Office, to the deployment area. These problems often become unduly magnified in the mind of the individual because he feels he is unable to cope with them. Working and living conditions, which can be less than ideal, have a similar adverse effect. The younger squadron pilots and crewmembers are particularly susceptible to this form of stress. Worries and anxieties which are psychological in nature adversely affect a person's physical condition. The results are an increased susceptibility to flight stresses and a decreased level of skill. Everyone has some personal problems but not everyone has developed enough self discipline to leave these behind as he approaches the flight line.

There are specific steps, however, that all can take which will minimize the effects of these stresses. The first of these steps is the realization that personal problems do influence flight performance. Secondly, one should take advantage of every opportunity to alleviate the burden of these problems by discussing them with a trusted confidant. The chaplain or your flight surgeon will lend a sympathetic ear. When one learns that his contemporaries have similar problems and that all are, more or less, in the same boat it becomes easier to place things in their proper perspective. Finally, the individual should develop self discipline to the point that he can leave his problems behind and devote full concentration to the task at hand on a mission.

The individual's role in the squadron's accident prevention program during a deployment must be an active one.

Unrelenting command attention can motivate personnel at all levels to perform in a thoroughly professional manner. Then and only then can the accident-free operations for which the aircraft weapons system was originally designed be achieved.

Survival Report

The strobe light was the primary means of locating an RA-5C pilot and reconnaissance attack navigator (RAN) who ejected after a midair collision at night in the carrier traffic pattern.

Pilot: "As I went back to the gages," the pilot begins his description of the collision, "I had a fleeting impression of a green and a dark shadow at the 2 o'clock position. I looked in that direction in time to see a foreshortened view of an aircraft. I reflexively pulled back and to the left but the impact was almost immediate. The aircraft pitched violently down and to the left. I heard an explosion from the rear—possibly the RAN ejection—and the cockpit filled with flame. I grabbed the right alternate ejection handle and pulled at least twice. My surroundings continued to burn brightly, and I have no awareness of leaving the aircraft. The cockpit was revolving rapidly and violently at the time the ejec-

tion handle was pulled, and in retrospect it seems probable that the aircraft had exploded and was falling in pieces.

"There was no perceptible time lapse between being enveloped by fire and then by water. I struck the water with sufficient force to stun me for several seconds during which time I was conscious of being under water and breathing but unable to move. Apparently I went under water several feet, dragging the parachute with me.

"I surfaced slowly and through a tangle of shroud lines. The canopy was beside me in the water. Useful consciousness seemed to return suddenly and the next movements were quite rapid. I released the starboard rocket jet fittings, pulled one CO_2 bottle on the Mk-3C, removed the oxygen mask and attempted to find the other canopy release. I removed the strobe light from its pocket, turned it on and held it in my mouth. I then realized that I was floating easily but was badly entangled in the parachute lines and canopy. I could not find the other rocket jet fitting at this time. I later found it between my legs. (*Difficulty with the fittings was attributed to the torso harness being too large.—Ed.*)

"I saw the RAN's strobe light nearby and called to him. He answered and paddled his raft over to me. We then worked on freeing my legs from the lines. The rescue operation was very smooth. The destroyer came alongside in a very few minutes. The ship's boat was put in the water and our pickup was expertly handled by the destroyermen. Their performance leaves nothing to be desired and is worthy of the highest praise."

RAN: ". . . the aircraft received a severe jolt. I noted a flash of light, my cockpit lights went out, and the aircraft began a violent pitch downward and to the left.

"I pulled the face curtain immediately. The ejection was mild, and the seat sequencing was normal. My chute deployed almost immediately and I stabilized quickly. As I descended, I noted another parachute streaming slightly behind me and to my right. This chute passed below me traveling quite rapidly. During my descent I pulled the D-ring. The descent took only a few seconds and my entry into the water was smooth and gentle.

"After entry, I first removed my oxygen mask. The left fitting came off fairly easily but the right one had jammed and I had to force it off. Next I deployed my Mk-3C life preserver, attempting to deploy shark repellent at about the same time. I then quickly turned on my strobe light, released my left shoulder and leg rocket jet fittings without difficulty, opened my seat pan and found and inflated my life raft.

"As I was doing this, I noted the pilot's light. He called to me and I responded. We were approximately 10 to 20 yards apart at this time. He stated that he was having difficulty with his parachute and requested that I paddle over to him. I yelled back that I would. I then attempted to release my upper right rocket jet fitting but was unable to do so and cut it away with my shroud cutter instead. I then boarded the raft without difficulty (the sea was quite calm) and began paddling towards the pilot. Since I was unable to locate the torso strap fastener for my strobe light, I pushed it down into my Mk-3C life preserver. It soon dropped outside the vest; however, I did not retrieve the light at that time, believing that it was secured to my torso harness by a cord. Unfortunately, this proved not to be the case and I suddenly saw it disappear over the side.

"I reached the pilot without difficulty shortly thereafter. He told me he was entangled in his parachute and did not wish to cut lines indiscriminately, fearing he might lose the lanyard to his life raft. He held on to the side of my raft and put one leg over the side. I was then able to cut the shrouds and parachute away from his leg and more or less disentangle him from his chute.

"The destroyer was bearing down on us rapidly now and soon had us in her lights. Fearing that the chute might be sucked into the main induction system, we both called a warning to the ship that the parachute was still attached. The ship slowed with us amidship on her port side and lowered a whale boat. The boat was on us in short order and the crew pulled us both into the boat without incident. We were taken to sickbay and were treated for burns."

Both the pilot and RAN sustained burns on their legs above the area covered by their boots.* The pilot's burns were the more extensive, probably because he was not wearing an anti-G suit, which allowed his flight suit to be loose around his legs. He also received burns on the left hand; he was not wearing gloves.

"A discussion of the survival gear involved in this accident is not complete without high praise for the strobe type survival lights," the investigating flight surgeon reported. "The plane guard destroyer officers felt that they were, perhaps, the most important items in a speedy and successful rescue. The lights were easily visible for several miles and gave the destroyers excellent guidance to the survivors."

*Aircraft Service Change 122 modifies T-2A and RA-5C ejection seats to reduce the possibility of such burns.

Protects on Impact

ON ground impact, the pilot of the A-1H was thrown forward although strapped in tightly. His hard hat and oxygen mask came off. After the accident inspection of the hard hat (which had a nape strap) showed a crack in front beneath the visor and a break in the left side above the oxygen mask fittings. The gun sight mounted directly forward of the pilot and on top of the panel was bent and pushed to the left where the pilot had struck it.

Impact forces were such that without the initial protection of his hard hat, the pilot would have surely received a critical or even fatal head injury, the investigating flight surgeon said.

"The importance of having the chinstrap and hard hat firmly secured should be emphasized at safety meetings and all pilots' meetings," the flight surgeon stated. "This accident is only one of the many instances on record in which the hard hat (saved) the pilot."

Combination Wrong

AFTER ejection, an A-4E pilot experienced a sensation of tumbling followed by a severe jolt causing the harness chest strap to rest against his throat.

"Chute opening was rather violent," the pilot recalls, "and the cutaway harness I was wearing at the time cinched up very tightly and brought the chest strap up to my throat, making breathing a little difficult. . . Once I was settled down, I finally released the chest strap to try and make the descent a little more comfortable."

The pilot landed in a field and was rescued by helicopter. His neck and body were bruised. He was grounded 24 hours because of slight difficulty in swallowing. The flight surgeon attributed his injuries to the abnormal distribution of forces on parachute deployment. The pilot was wearing an MA-2P torso harness over a summer flight suit.

The MA-2P torso harness is designed for use with the Mk-4 life preserver and full pressure suit only. (Whether or not the pilot was wearing any kind of life preserver is not reported.) Naval Air Systems Command message 072159Z of February 1966 states: "Wearing MA-2P over flight suit cannot be authorized as MA-2P is sized and patterned for proper fit over pressure suit and in present configuration will not provide optimum ejection/crash restraint when worn over flight suit."

Crew Lucks Out

THE crew in a C-117D ditching did not take proper ditching stations. They elected to sit on the deck without any restraining straps because the plane captain did not believe the seats were safe. Two crewmembers sat with their backs to the bulkhead facing forward, "the worst possible position," the AAR states. The pilot was unaware of this situation until afterwards.

"The flight crews at this facility are all aware of the correct ditching stations in all its aircraft," the investigation board reported. "It is therefore hard to explain why in an actual emergency they deviated from their training."

"Due to the soft landing no one was hurt in the accident," the investigating surgeon states, "but if it had been hard, the injuries would have probably been severe."

Escapes Underwater

FOLLOWING a nosewheel first landing, a T-28C went over the side after the hook disengaged as the nose strut failed. The NavCad pilot escaped from the cockpit at a depth of from 30 to 40 ft. He paddled to the surface and was rescued by helicopter. He sustained only minor cuts and bruises and irritated eardrums with rupture of capillaries in the external ear canals due to increased pressure at depth.

"Undoubtedly," the investigating flight surgeon reported, "Cadet ——'s Dilbert Dunker training was largely responsible for his survival. . . It is imperative that the students continue to have emphasized to them the importance of reviewing their emergency escape and survival procedures prior to each hop."

In the Dark

Recommendation: To simulate a night survival situation over water, that all pilots hang in torso harness in a dark room and learn to locate survival equipment by touch . . .

—From an AAR

Lose Respect

Item: Flight deck and jet squadron personnel have lost all respect for the hazards of reciprocating aircraft propellers. With only five reciprocating aircraft on board, personnel have either forgotten or have never been briefed to stay out of the propeller arc even when the propeller is not rotating. Personnel are habitually walking through the propeller arc of stationary propellers. . .

Action: Units brief all hands to never walk through stationary propellers lest they tangle with a rotating propeller in utilizing a habitual path around aircraft.

—Safety Council Minutes

Position Poor

AN F-8E pilot made no conscious effort to position himself properly in the seat in spite of the fact he was in a controlled ejection situation. He leaned forward as he pulled the curtain and pulled it with his left hand only. Too late, just as he was pulling the curtain, the thought flashed through his mind that he was not well-positioned. He sustained a compression fracture of a lumbar vertebra.

Surprisingly Simple

THE entire evolution from the original emergency through rescue was surprisingly simple. I had never ejected from an aircraft nor had I ever experienced a severe emergency that required rapid analysis and immediate action. I can only reiterate what many have said—that hours of emergency drills and training really pay off.

—A-4E pilot

Post-Combat Letdown

A FLIGHT surgeon reporting from Vietnam remarked on the fact that all three fatal F-4B accidents which he has investigated occurred *after* the combat phase of the mission was complete. "Perhaps," he writes, "there is such a thing as 'post-combat complacency,' a phenomenon where the pilot 'relaxes' after the dangers of combat are over."

After a fighter crew has successfully surmounted the rigors of combat, what factors are operating to produce these anticlimactic casualties? Is there a premature relaxation of vigilance brought about by attitudes of exhilaration or overconfidence? Is this, perhaps, further enhanced by fatigue?

In any case, as the flight surgeon states in his report, "Whether on a combat mission or not, the adage that the dangers are not over until the wheels are in the chocks bears constant reiteration."

Compression Fracture

ON first impact in a forced landing, the T-28 pilot apparently was thrown forward with his spine flexed. This resulted in a compression fracture of a vertebra. His harness was locked but his straps were loose.

Flight surgeon's recommendation: That increased emphasis be placed on the importance of not only having the shoulder harness locked but insuring that the harness is tight enough to hold the pilot in an erect position during a forced landing.

DELTA P FILTER INSPECTION

Although this article deals directly with the Phantom, these principles apply to all modern high pressure hydraulic systems. A daily look at the buttons can save you a lot of work.

Daily inspection of the Delta P (pressure drop) indicator buttons on certain utility hydraulic filters is one of the most important steps in maintaining system reliability. It is a quick and easy check, and yet it is being widely neglected. Maybe one of the reasons for this neglect is simply a lack of familiarity with the indicators and their location; another reason may be a lack of understanding as to why this required check is so important. In the hope that more information will help out in both these cases, we'll discuss as clearly as we can what a Delta P indicator does, how it does it, what filters have them, why they have them, where to find them, and finally the possible consequences of allowing these filters to clog up by neglecting the inspection of them. That sounds like a lot, but it is really pretty simple. In fact, it's already in the handbooks and work cards; but by putting it all together in one place, we can give it some additional emphasis and perhaps clear up a few questions.

First of all: what does a Delta P indicator do? It is a device built into the filter housing that senses the differences between input and output pressures to and from the filter. The restricting action of the filter element causes the output pressure to be lower than the input. This pressure drop, called "Delta P" in engineering language, naturally grows larger as the filter element clogs up and offers more restriction to flow. When the pressure drop reaches a predetermined level, the indicator pops up.

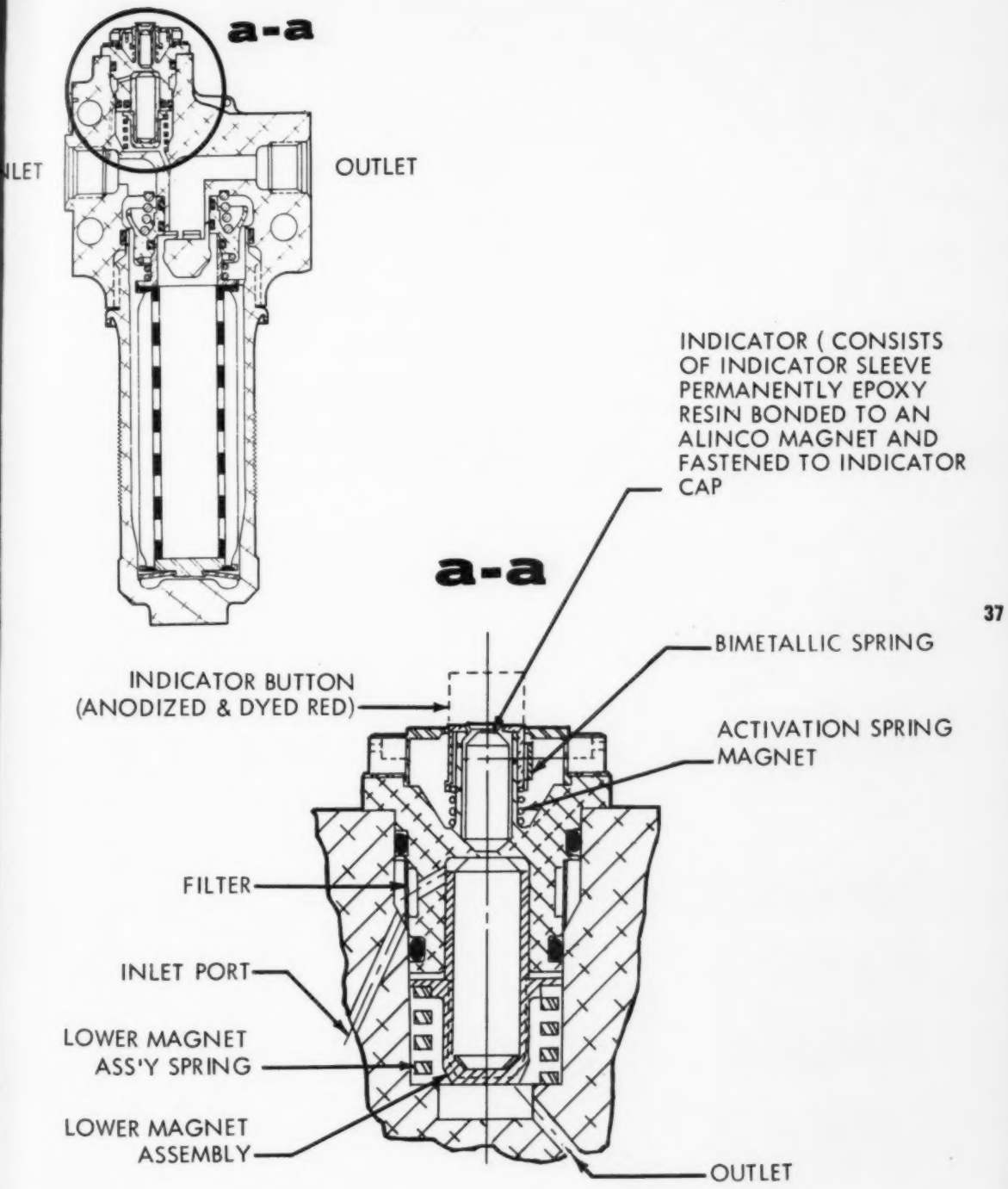
The pressure drop value that triggers the indicator is less than that required to open the by-pass valve, if the filter has one. This is the main purpose of the indicator; the button will usually pop up a flight or two before the by-pass opens. This gives you the opportunity to change or clean the filter before it begins passing contamination particles downstream to the rest of the system. To take advantage of this opportunity, however, you *must* check the indicator daily.

Some filters with Delta P buttons do not have by-pass valves. When they clog up, they partially block the flow of hydraulic fluid, with consequences that we'll discuss later. The button will pop before blocking becomes excessive, however, so daily checks will enable you to avoid this condition also.

The way a Delta P indicator operates can be seen in the accompanying cross-section drawing.

As you can see, it consists of two spring-loaded permanent magnets. The upper one carries the indicator button. The lower magnet, which is in the form of a free piston, is subject to filter inlet pressure on its top surface, and outlet pressure on its bottom surface. When the forces exerted on the lower piston by outlet pressure and the lower spring are greater than the force exerted by inlet pressure, the piston is held at the top of its travel. The small upper magnet is then within the field of the large lower one, and is held down, the magnetic attraction overcoming and compressing the small upper spring.

As the filter outlet pressure drops because of ele-


a-a
NLET
OUTLET
INDICATOR (CONSISTS OF INDICATOR SLEEVE PERMANENTLY EPOXY RESIN BONDED TO AN ALINCO MAGNET AND FASTENED TO INDICATOR CAP
a-a
BIMETALLIC SPRING
INDICATOR BUTTON (ANODIZED & DYED RED)
ACTIVATION SPRING MAGNET
FILTER
INLET PORT
LOWER MAGNET ASS'Y SPRING
LOWER MAGNET ASSEMBLY
OUTLET

ment clogging, the inlet pressure begins to overcome the forces of the outlet pressure and the lower spring, forcing the lower magnetic piston downward.

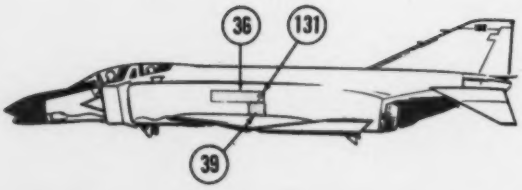
At a certain pressure differential (determined by the calibrated strength of the lower spring) the lower magnetic piston is forced down so far that the magnetic attraction is weaker than the upper spring, which then pops the upper magnet up, carrying the red indicator button with it. Note that the magnetic field acts through the solid housing—there is no hydraulic passage between upper and lower magnets.

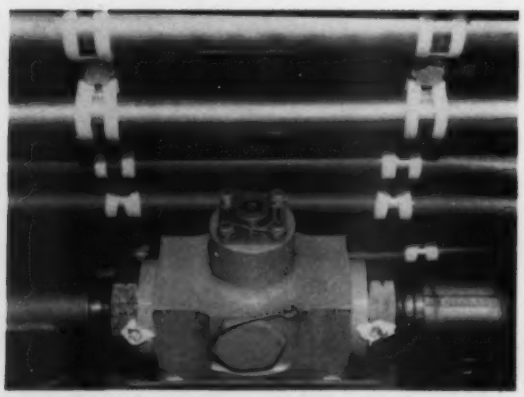
The button will stay up until it is pushed down again manually. It will pop right up again, of course, if you push it in with system pressure applied and something being actuated to produce flow through the filter, unless you have remedied the pressure drop by installing a clean filter. If you push it down with no system pressure or flow, it will stay down. This brings up a point of caution. *Don't push the button down under these conditions unless you have changed the filter element;* if you do, everything will appear all right to the next man who makes the next check. But it's not all right; the filter is still dirty, and the button will pop up again when an engine is started and the system begins working. But nobody will see it until the next check.

There is one justifiable exception to this rule. If you have a good reason to suspect that a button has popped just to annoy you, like maybe you put in a clean element only yesterday, push it in and let it go one more flight. If it stays down, OK. If it pops up again, change the element and look for the source of contamination.

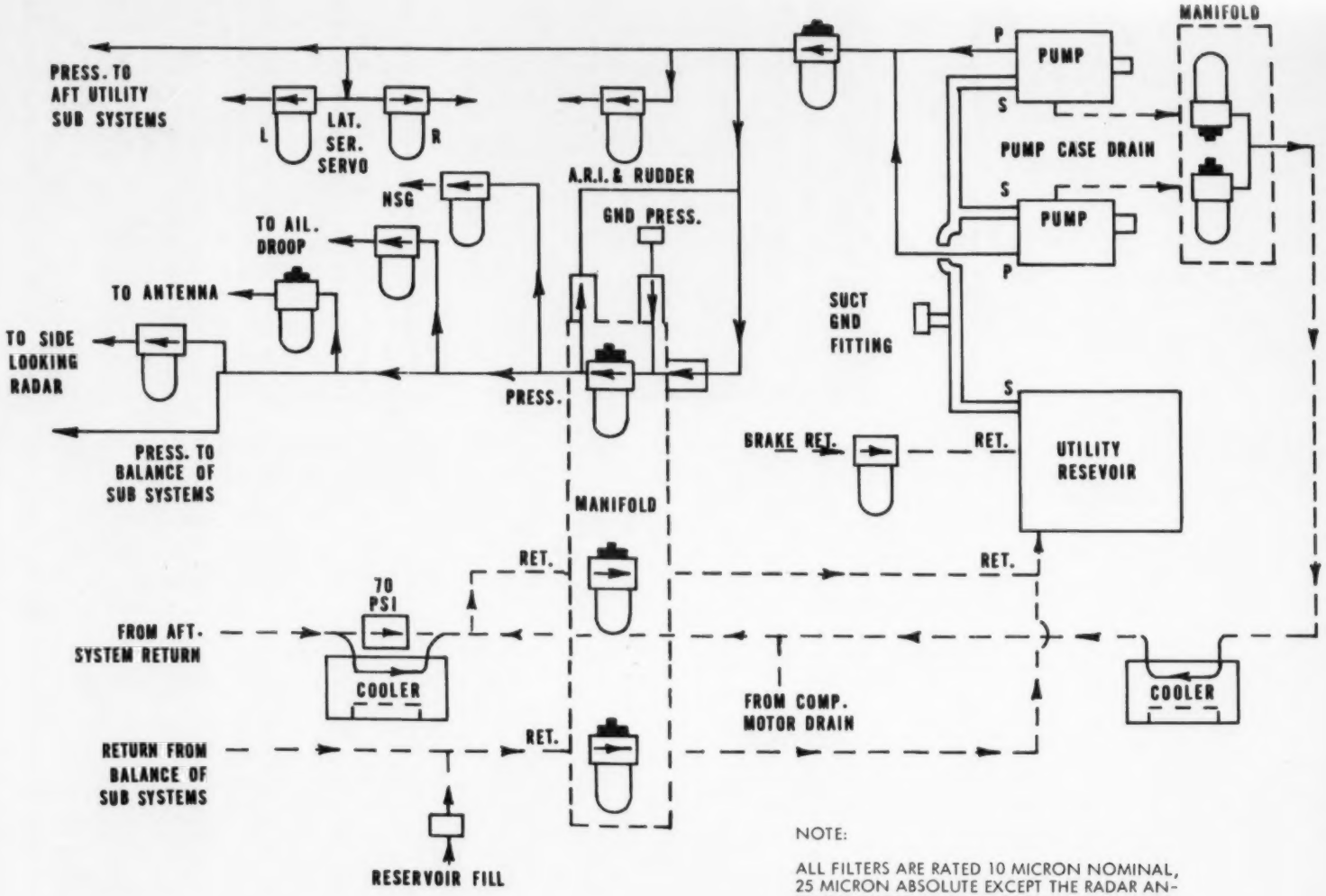
One filter in particular has been prone to do this: the aft systems return filter (locate it on the schematic and pictures later in this article). To protect the transfer pumps, it is set to pop at a lower value than the others. Surge pressures from tail hook extension and other hydraulic mysteries sometimes make it pop although the filter is clean. MAC engineering is working on an improvement to stop these false alarms. Don't let any misbehavior of this one button shake your faith in the others. They're a very reliable and convenient indication of the condition of the utility hydraulic systems.

One more mechanical detail should be noted before we leave the cross-section view. There is a temperature-sensitive bimetallic spring that prevents the button from popping up at low temperature, when high fluid viscosity would give a false pressure drop. Above 80°F it moves out of the way. This is filter housing temperature, not ambient temperature. The hydraulic fluid quickly heats up the housing when the system is operated.





Pressure Filter



NOTE:

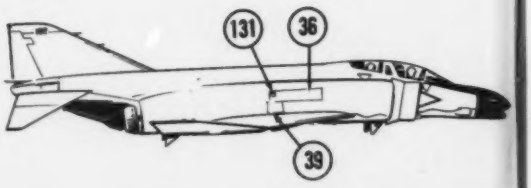
ALL FILTERS ARE RATED 10 MICRON NOMINAL, 25 MICRON ABSOLUTE EXCEPT THE RADAR ANTENNA FILTER; IT IS 2 MICRON NOMINAL, 15 MICRON ABSOLUTE

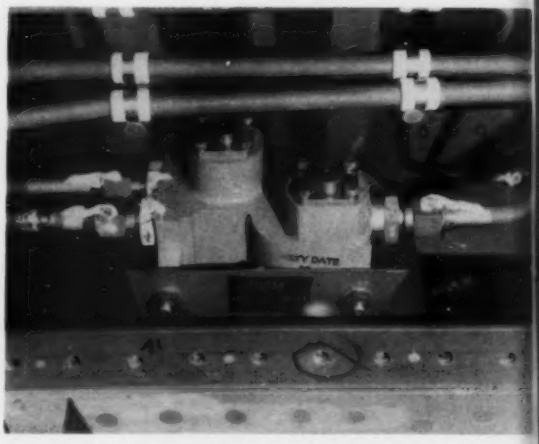
Now for the location and purpose of each filter having a Delta P indicator. Their system location is shown in the schematic. Their physical location is covered by the photos.

Let's consider the pressure filter first. This is a bypass filter, so if it clogs up, any contamination particles coming from the pumps go on out into the entire system. It is located inside door 36L. You can see it through a bullseye door (131) that is fastened by only one screw. If you have to change the filter element, go in through door 39 just below it. This gives more convenient access to the filter bowl. There is a handy trick to installing new lock wire. Attach it to the filter bowl while it is out of the aircraft, of the same length and in the same position as the old wire. This saves much fiddling around in cramped quarters after the bowl is reinstalled.

Also immediately associated with the pumps are the two case drain filters. These have indicators but no by-pass valves. Clogging of these filters and the resulting increase in flow restriction can damage the pumps. To understand the consequences of this, consider what the pump case fluid does for us: it is the hydraulic fluid that passes through the balance-pressure holes in the piston shoes, and is discharged into the case from compensator operation. It washes, lubricates, and cools the working parts of the pump; therefore, it needs to be constantly drained, cleaned, and cooled. Hence the case drain filters as they begin to clog up and offer more flow restriction, the pump case pressure builds up. This has a bad effect on the running shaft seal and the gaskets of the pump case. If it builds up high enough it may blow a gasket or the shaft seal, losing the utility fluid and causing system failure. In fact, this has been a fairly common cause of system failure. In addition, high case pressures reduce the case drain or cooling flow by causing oil in the pump case to route back to the suction port via internal leakage paths within the pump. This, of course, causes overheating of the pump. Also, clogging can cause the filter element to distort and twist.

The reason that these filters don't have by-pass valves is that the case drain fluid carries most of the normal pump wear particles; if these were allowed to by-pass the reservoir and back to the pumps, creating the well-known vicious circle that ends in destruction of the pumps. They must be positively stopped somewhere, and that place is the case drain filters. More important, these filters prevent debris from a sick pump from ruining the good one, thus giving two-pump reliability.

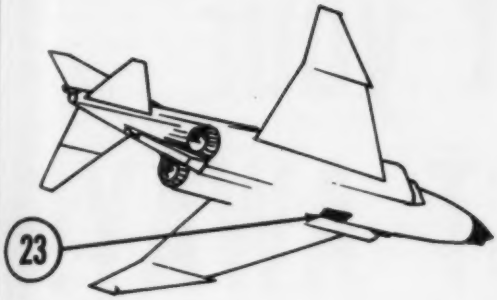


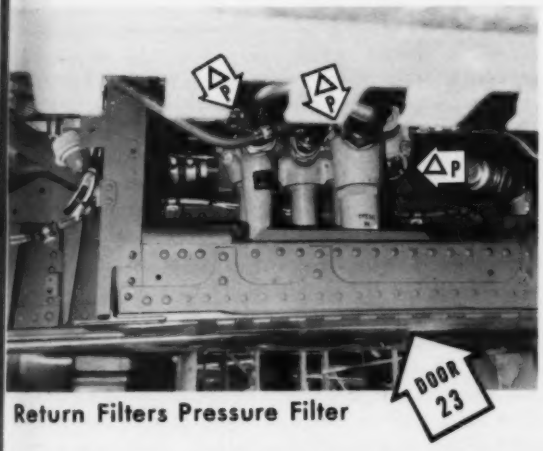


Case Drain Filters

These case drain filters are physically manifolded together, and the buttons can be checked through a bullseye (131R) in door 36R. As with the pressure filter, change the case drain filter elements by removing the smaller door below (39R).

To point out the importance of daily inspection of these two filters, about 90 percent of the pump failures are in the utility system. Types of failures indicate that a large percentage of the problems are caused by high pressures and loss of case drain cooling flow. Good maintenance on these filters can





Return Filters Pressure Filter

definitely correct this and reduce pump failures.

Three more Delta P filters are also mounted together. One is the pressure filter that cleans ground-cart pressure fluid before it enters the aircraft system. This button can be a help in analyzing the source of suspected contamination. If it is popped and the aircraft pressure filter button is not, contamination is most likely coming from the ground-carts. If this is ignored, the aircraft system can become contaminated, since this is a by-pass filter.

The other two are return filters, to clean up the fluid coming back from the utility subsystems before it gets to the reservoir (and from there to the pumps, where dirty fluid would produce the self-generating wear cycle we've already described).

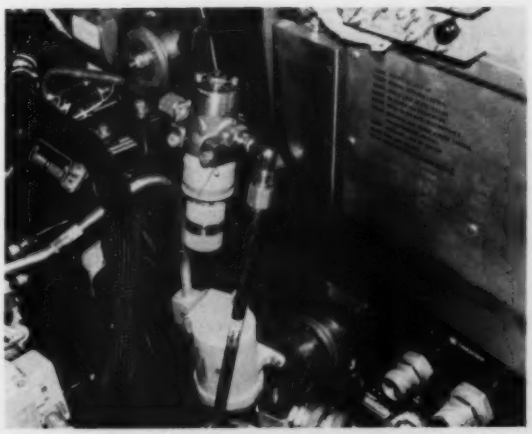
These three filters are easily accessible for checking and element replacement inside door 23.

That leaves only one more Delta P filter which is not a daily check item. This is the pressure filter that gives extra-fine cleaning to fluid for the radar antenna motors in fighter types only. This can easily be seen, and reached, when the radome is open. Inspection and maintenance of this filter is normally performed by radar personnel. It is a non-bypass filter; excessive clogging will slow down antenna motion.

Only four places to look—three if you're in a recco squadron. It isn't much trouble to check these buttons, and it can save a lot of trouble in flushing, pump replacements, and other types of trouble-fixing. Remedial maintenance is always more trouble than preventive maintenance.

And—a daily look at the buttons just might save a great deal of trouble for some pilots and crash crews.

—McDonnell "Field Support Digest"



Pressure Filter

Don't let your engine RUST AWAY!

A J79 engine with only 222 hours since new was received with heavy rust in the compressor. The engine had not been preserved, and the compressor and most of the rest of the engine had a lot of salt deposits.

You are all aware, doubtless, of the effects of salt on uncoated metals. Lube and fuel components cease to work, and other parts rust and pit to the extent that they must be replaced, or many hours of valuable time must be spent cleaning and reconditioning them.

Instructions are provided for preservation and it is imperative that these instructions be followed.

For Navy engines, there are five types of preservation. Each includes treatment of the lube system, the fuel system, and the compressor. However, compressor preservation is not required if all the blades and vanes have been painted.

Types of Preservation

Type I—for engines that are to remain inactive for unknown or extended periods of time. This type of preservation is primarily for the protection of new, newly-overhauled, or operable engines being returned for overhaul or minor repair.

Engines that are being removed from one aircraft for installation in another and the elapsed time between removal and reinstallation is unknown should be preserved by Type I methods.

Following preservation, the engine must be stored in a metal container. An engine may be stored indefinitely when preserved in this manner.

Type II—identical to Type I, except that the engine is stored outside of a container. This type is primarily for operable engines which are stored under cover (indoors or on a hangar deck) for more than 30 but not more than 120 days.

Type II protection may be used for engines being prepared for air shipment; for engines that have failed test-stand checks and must be returned to the shop for minor repair and adjustment; and for low-time engines being removed from an aircraft and scheduled to be installed in another.

Type III—for operable engines stored under cover for periods not to exceed 30 days.

Type IV—for inoperable engines being prepared for storage and shipment, except those that have been immersed in water or have been involved in crashes or fires where fire-fighting chemicals have been used.

Type V—for engines that have been immersed in water (salt or fresh) or have been sprayed with fire-fighting chemicals. Following this type of preservation, the engine should be placed in a metal container and shipped to overhaul immediately by the most expeditious means available.

Note that time is an important factor and that engines in any state of storage must be preserved in some manner.

Type I—storage for an unknown period. Flush the lubrication system with engine lubricating oil, the fuel system with oil, Mil-0-6081, grade 1010, and spray the compressor with engine lubricating oil. Store the engine in a metal container pressurized to 5 psig with dehydrated air and containing dessicant bags. Storage period—indefinite.

Type II—storage for more than 30 but not more than 120 days. Type II preservation may be renewed for one additional 120-day period. Procedures are the same as those for Type I except engines are stored under cover and not in a metal container. At the conclusion of the preservation period, 240 days total, the engine must be placed in service or stored in accordance with Type I methods.

Type III—for periods not to exceed 30 days. Flush the fuel and lube systems as in Type I and spray the compressor. May be renewed for an additional 30 days.

Type IV—for inoperable engines not to exceed 120 days without renewal. One renewal period of 120 days allowed. Use Type I methods if longer storage periods are required.

Type V—for water-immersed or chemically-treated engines. Expeditious handling required.

Maintenance or Preservation

Inspection of Pressurized Containers—immediately upon receipt and at least once each 90 days thereafter, check the pressure and humidity of the container. Pressure shall be positive and the humidity indicator must be blue. If the pressure does not show positive but the humidity indicator shows safe (blue), repressurize the container with dehydrated air to 5 psig. No further action is required.

If at any time the humidity indicator shows unsafe (pink), the container will be opened and the engine will be inspected for corrosion, repaired as necessary, represerved and reinstalled in a container; place fresh dehydrating agent in the container. For more detailed information on inspection and repairs to engines installed in pressurized containers, refer to NavWeps 15-02-500, "Preservation of Uninstalled Aircraft Engines."

Type II Preservation—all openings shall be kept appropriately sealed with manufacturer's closures or water- and vapor-proof materials. All closures shall remain in place until it becomes necessary to install accessories or other equipment or until the engine is placed in service. At no time will an uninstalled engine not protected with a dehydrated metal container be placed in outdoor storage unless a waterproof cover is installed over the entire engine.

Every 30 days following preservation, the necessary closures shall be removed and the engine motored in accordance with applicable instructions. If the 30-day maintenance requirements are observed, the engine may be kept in Type II status for a total of 8 months.

If the 30-day maintenance requirements cannot be observed, Type II storage is limited to a maximum of 60 days and, in addition, the compressor rotor must be turned by hand, one-quarter turn every 10 days. If needed, the compressor shall be resprayed every 30 days at the time of engine turn-up.

Type III Preservation—is basically operating maintenance using normal service fuel in the fuel system and operating lubricant in the oil system. Engine air intake and exhaust openings are kept closed with dust covers to prevent circulation of moisture—or dirt-laden air through the engine.

The storage time limitation for Type III preservation is 30 days, and at the end of that time the engine shall be operated to renew preservation completely. In emergency situations where a ground run is not possible, Type III preservation may be extended an additional 30 days by motoring the engine to 900-1150 (12-15 percent) rpm with normal service fuel connected to the engine fuel inlet, and engine oil in the lube tank. Turn the engine up to 900-1150 rpm. Cycle the throttle from zero to 110 degrees twice. If the compressor needs respraying, do so while the engine is being motored.

Type IV Preservation—same as Type II maintenance requirements.

Type V Preservation—same as Type I maintenance requirements. The inspection interval shall be 30 days for the period during which the engine is awaiting shipping space. Engines in this category shall be shipped to the nearest overhaul depot as soon as possible.

Additional details for methods of preservation are included in the Intermediate Maintenance manuals. Even though engines cannot be operated, they can be properly preserved, and preservation in accordance with existing instructions is a must for engines to be stored even for a short time.

Compressor Spraying

Whenever compressor spraying is called for, it is to be accomplished as follows:

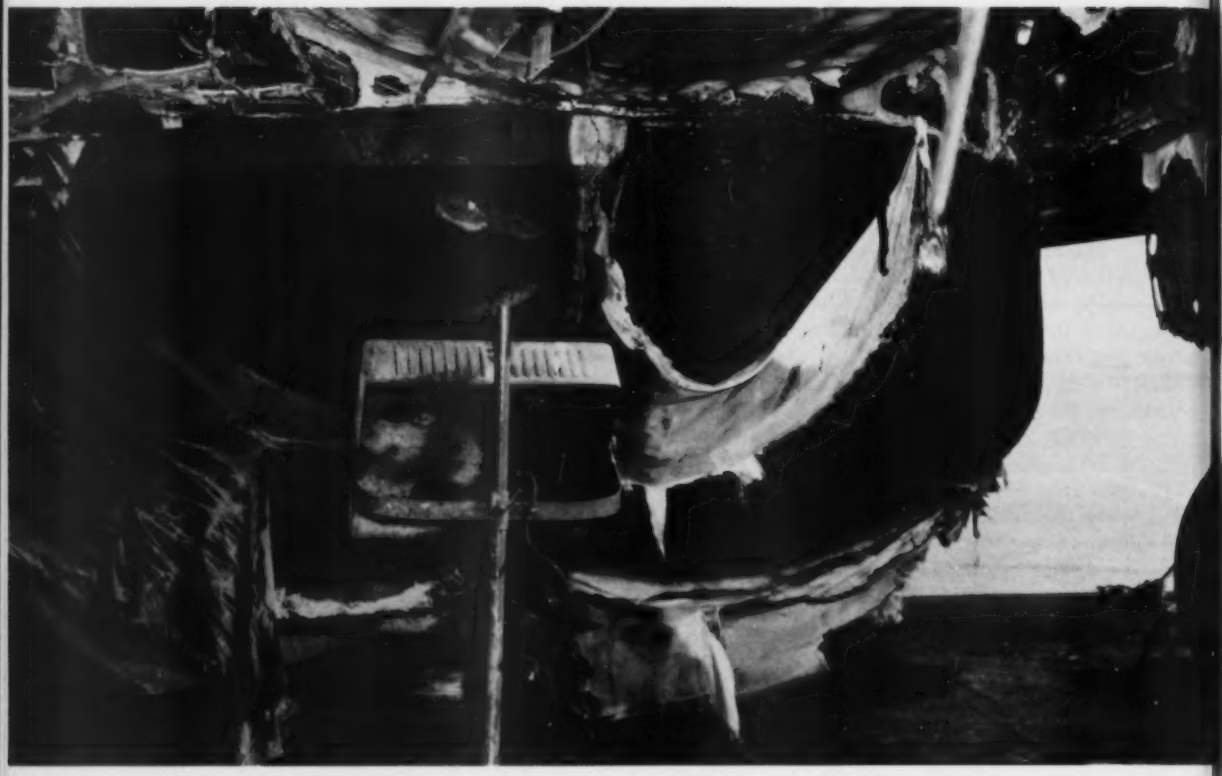
Caution: If the engine has just been run, do not spray the compressor until the engine has cooled sufficiently to prevent auto-ignition of the preserving oil.

Run up the engine to the highest speed attainable or to 1200 rpm, whichever occurs first. De-energize the motoring power and allow the engine to coast down.

As soon as the engine rotor begins to turn, begin spraying the compressor; rotate the spray nozzle, and spray one-half to one pint of engine lubricating oil into the compressor inlet while the engine is accelerating and coasting down. If the engine cannot be rotated, spray as much of the compressor as possible without rotation. —*GE "Jet Service News"*

NOTES

and comments on maintenance



Reconstructed position of lamp bank in front of radome.

Lamp-Heat Caused Fire

SEVERE fire damaged an EC-121 during radome deicer boot installation in which a bank of 8 infrared heat lamps was used to speed up the cement drying process.

The lamp bank was positioned about 14 inches from the radome and had been left unattended. Fire resulted when concentrated heat radiated from the lamps located in close proximity to the highly flammable surface. The fire was further intensified by four 1-gallon cans of 3M EC 1300L cement and two 5-gallon cans of methyl-ethyl-ketone in the repair area.

Upon discovery of the fire several men fought the blaze with CO_2 extinguishers until fire trucks arrived on the scene about four minutes later and extinguished the fire. The aircraft had 6000 gallons of fuel aboard.

It was determined that use of heat in cold weather for deicer boot installation is an approved practice

and in accordance with maintenance instructions for this aircraft, and was necessary in this case, to accomplish the work performed. However, no operating or safety instructions existed for use of the lamp banks.

Normally, the lamp bank is equipped with 250-watt bulbs. Since the supply of replacement 250-watt bulbs was exhausted, 375-watt bulbs were substituted. The accident board could not determine how many of each were in the fixture since all of the bulbs exploded in the fire but did establish that a mix existed.

The board recommended:

- that complete and comprehensive operating and safety instructions for the type lamp bank be written and enforced within the squadron. It noted that heating devices, as with any ground support equipment, must be used only within design limitations and only by qualified personnel;
- that whenever heat devices or any electrical equipment are being used, a continuous watch be maintained, and
- that work areas be kept free from excess flamable materials.

Lesson in FOD Prevention

LET it be understood that this article is not Monday morning quarterbacking but it does point out the advantages of hindsight. It appears here so that you do not become a victim of a similar situation.

After three unscheduled engine changes in one day for FOD it didn't take long to discover a strong suspicion. Over night the gravel pile shown in this photo was deposited on the parking mat. This was done to avoid contamination of the gravel. In the hauling process spills and tracking-in resulted in gravel being strewn on the taxiway.

Runway resurfacing material piled adjacent to aircraft taxiway caused FOD to three engines in one day.

The reporting activity observed that in view of the general knowledge of the runways being resurfaced, the time to look for associated problems is before they occur. Proper precautions should be taken when handling or storing construction materials around aircraft.

It was also recommended that vehicles operating on aircraft ramps, taxiways and runways be equipped with open tread tires to lessen the possibility of tracking foreign objects.

Fuel Fubar

What?—Transient S-2F was refueled with JP-4 fuel instead of grade 115/145.

How?—The wrong type of fuel was delivered alongside the aircraft. Notwithstanding the fact that the refueling vehicle is marked "JP-4 JET FUEL" on both sides in one-foot letters and a placard on the middle of the dashboard reads "JP-4" in three-inch red letters, this error was attributed primarily to two factors:

(1) The JP-4 vehicle involved is rarely parked by the refueling office (which is used as the staging area for all refueling operations) as is the 115/145 refueler. Both vehicles are 2000-gallon capacity units and nearly identical in appearance. In this instance, the JP-4 refueler had been parked by the refueling office for minor maintenance work and the key had been left in the ignition.

(2) When the request for fuel was received at the refueling office, a rainshower was approaching the field. The driver, anxious to refuel the aircraft before the shower arrived, hastily manned the JP-4 refueler, assuming it to be the 115/145 vehicle, and drove it to the aircraft. He relied on his faulty assumption that the JP-4 refueler is "never" parked by the office.

Local refueling instructions direct that the plane captain check the refueler service truck for identification of fuel and to take a sample of the fuel to verify its color and cleanliness before dispensing. The plane captain in this case neglected to follow correct and published instructions.

Commanding Officer's Comments—This mishap illustrates that people and *only people* can bring about safety in our daily endeavors. Directives alone will not prevent mishaps. It is people, performing with the guidance and within the scope of well-established precepts that bring about safety in any operation. This mishap will be given the widest possible dissemination in the hope that this truism will be a lesson to all hands.

MURPHY'S LAW

**If an aircraft part can be installed incorrectly, someone will install it that way!*

TF-9J Murphy

WHEN a hydraulic system elbow fitting failed in flight, the TF-9J pilot attempted to blow the landing gear down with emergency air system. He was unable to do so because the main landing gear door remained closed. A landing on a foamed runway utilizing E-27 arresting gear resulted in port wing damage requiring wing replacement.

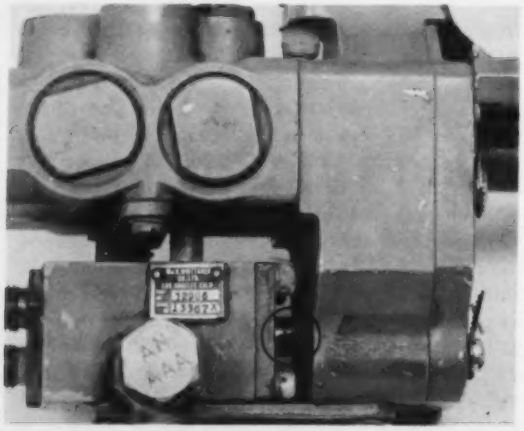
Cause of the gear-up condition was determined to be a mispositioned landing gear door control valve, below. The rotor had been installed 90 degrees out of phase. Its simple square shaft design permits installation correctly, 90, and 180 and 270 degrees out of phase (see photo at right).

The correct installation is depicted in the MIM NavAer 01-85FGF-2-2. The applicable portion of Fig. 2-119 is reproduced here (illustration lower right).

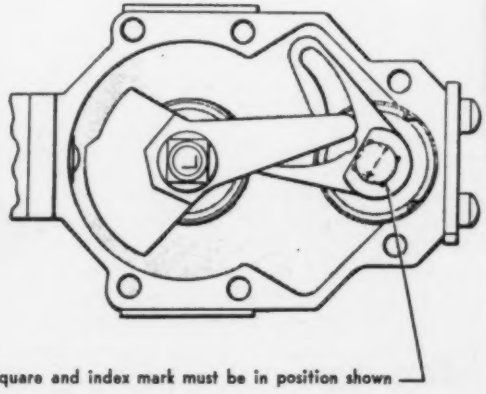
In addition to the original misinstallation during PAR, errors were also committed by O & R and the reporting squadron. O & R failed to functionally check the pneumatic system following PAR—the squadron failed to functionally check the system during an intervening Calendar Inspection at which time the gear should have been pneumatically actuated.

It was recommended that PAR activities make such checks and that operating activities comply with existing directives.

2. Bench marks (circled) for valve alignment



1. Landing gear door control valve rotor control rod (circled)



3. Square and index mark must be in position shown

Letters

Torque Troubles, Too

Wethersfield, England—"Using the Torque Wrench," (pages 39-42 in your Oct '66 issue) is of great concern to this wing and it is felt that dissemination of your article throughout this unit would be beneficial.

We request your permission for local reproduction.

20 TFW
ROYAL AIR FORCE

• Permission granted. Improper torquing appears to be a universal problem.

Hoisting Technique

NAS, Lakehurst—Concerning the item "User Report" in the September 1966 Notes from Your Flight Surgeon section, under *Hoisting Technique*, you state that loose cable on the surface could entangle with a parachute.

Here at HC-4 our crews are trained to keep clear of deployed parachutes while attempting a rescue. If the survivor is not well clear of his parachute, the crewman is instructed to make a water entry and remove the chute prior to the helo approaching the survivor.

Hovering over or allowing a man with a deployed chute to secure himself to the helo hoist cable could spell disaster for all concerned.

We are in agreement on not allowing an excessive amount of cable to accumulate near the survivor; however, it would be very difficult to keep the cable taut while performing a rescue.

First the rescue device must be put into the water prior to making contact with the survivor to discharge static electricity. Secondly, due to the extreme difficulty in maintaining a stable hover at sea due to the lack of fixed reference points, there must be a certain amount of slack in the cable.

PR1 W. D. MCCRAW
HC-4

• We are happy to add your comments on helicopter rescue to those of VA-64 which authored "User Report."

Mk-79 Mod O Pen Gun

MCAS, Cherry Point—The following is a quote taken from the September 1966 *USAF Study Kit for Flying Safety Officers*: "This was second pen gun and fourth flare of second bandolier of seven flares. The entire lot was suspended from use locally. An interim safety supplement was issued by OOAMA (TO 11A-1-155-189, 4 Aug) which authorizes disposal of all locally purchased signals, pen gun, Mk-79, Mod-0 manufactured by Pen-Gun Associates, Inc. The USAF standardized replacement is signal kit, personnel distress A/P 255-1, FSN 13 70-921-6172-LY35, which may be procured through regular requisitioning procedures as local purchase signals. Pen gun, Mk-79, Mod 0 no longer authorized for use."

Since the Mk-79, Mod 0 is the approved flare gun for crew survival use in the Navy and Marine Corps, has there been any recent modification to the approval because of malfunctions or is any contemplated?

LTCOL W. T. WITT, JR.
ASO 2ND MAW

• The Mk-79 Mod 0 is still the Navy's and Marine Corps' approved flare gun. The malfunction reported by the Air Force was on a different model from an early lot placed on the market for open purchase. The Air Force's replacement signal kit, personnel distress A/P 255-1, FSN 1370-921-6172-LY35, is similar to the Mk-79 Mod 0 outside but is a newer product. The present Navy Mk-79 Mod 0 kit is under FSN 1370-866-9788-X667.

Old Photos Never Die

NAS, Miramar—I just recently took over as ASO of Fleet Composite Squadron SEVEN and while cleaning out the old files I discovered a number of old photographs you might be able to put to good use. I remember while attending the Safety Center's 5-day safety course it was mentioned you could always use new material.

In case you might be interested, VC-7 still claims to be the "safest composite squadron in the Navy." We just recently passed 32,000 accident-free hours. These hours were accumulated in just 31 months while flying different models of aircraft. VC-7 doesn't take all the credit in this regard, for we feel that the Naval Aviation Safety Center . . . has contributed substantially to our outstanding record. . . .

LT R. J. DEIBERT
ASO VC-7

• Thanks for the photos and congratulations on a fine safety record. They make a dual contribution to the cause of aviation safety. has a continuing need for material and photographs of good quality such as you have submitted. Assistance from you or other sources in this regard will be greatly appreciated.

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Vol 12 **approach** No 8

Our product is safety, our process is education and our profit is measured in the preservation of lives and equipment and increased mission readiness.

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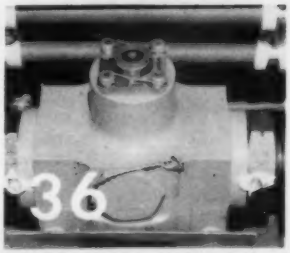

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Be careful of that ice on the taxiway!

"We were taxiing in from the helo landing area after a 19-day detachment aboard CVS-Hunter Killer. We had operated off the coast of Florida where the weather was warm, windy and rainy. The cruise was over now and we felt proud of our accomplishments while at sea. We had killed the subs and logged many night actual instrument hours.

"About 50 yards directly ahead of us was parked an SH-3A, one of our squadron aircraft, and between it and us was a solid sheet of ice with snow banked high along both sides of the taxiway. We were going downwind (the wind was 25 kts), and I knew we were approaching a dangerous situation and possibly a serious accident. Before taxiing onto the ice I told the copilot to stand by to give us full power in case the aircraft started to slide.

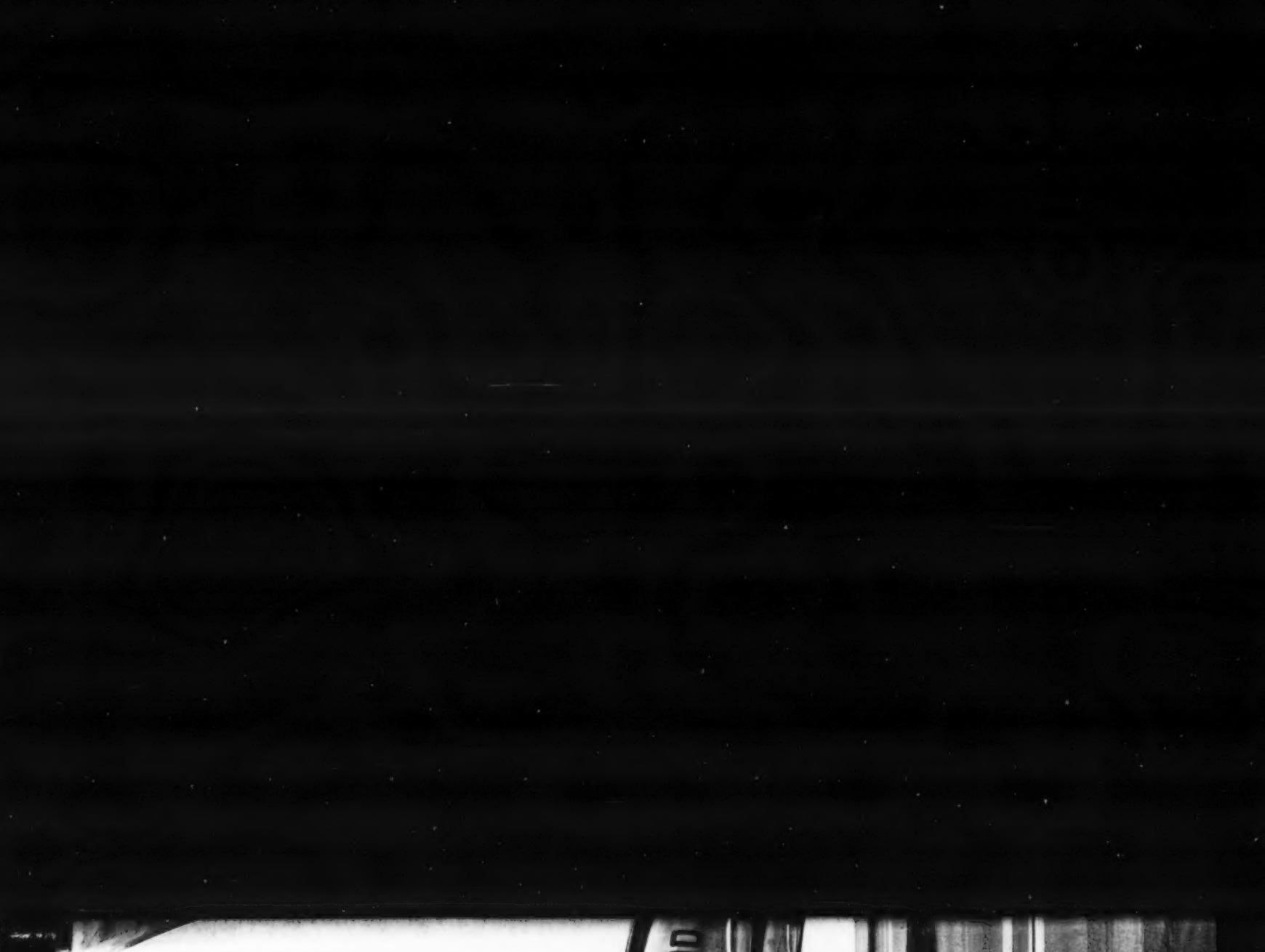
"We were about 50 ft from the parked helo as the wind blew us across the ice like an 'ice boat.' I had the brakes depressed to the floor, but we were still sliding forward with increasing speed.

"As I came up on the collective, I put in left rudder to swing the bird into the wind as the wind was on my port quarter. The heavy rotor blast, blowing snow and the swinging tail rotor made the taxi director hit the deck. Fortunately, he was much more surprised than injured.

"Without further incident, I air taxied to the parking area, landed and shut down. This could have been one tragic way to end a cruise and the whole thing could have been avoided if the following had been performed:

1. I should have shut down short of the icy area and let the line crew tow it from there.

2. Snow removal teams should remove not just the snow but all ice from wherever aircraft are going to land or taxi."

LIFT and DRAG

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